GENERAL MOTORS CORPORATION ANNUAL REPORT 1972

GENERAL MOTORS CORPORATION SIXTY-FOURTH ANNUAL REPORT

YEAR ENDED DECEMBER 31, 1972

CADILLAC SEDAN DE VILLE

CONTENTS

COVER: CHEVROLET MONTE CARLO "S"

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Stock Transfer Offices

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220 W. Congress Street, Detroit, Michigan 48226
21 King Street, E., Toronto 1, Ontario
1350 Sherbrooke Street, W., Montreal 25, Quebec

The Annual Stockholders' Meeting

will be held on May 25, 1973, in Detroit, Michigan. It is expected that proxy material will be sent to stockholders beginning about April 18, 1973, at which time proxies for use at this meeting will be requested.

GENERAL MOTORS HIGHLIGHTS

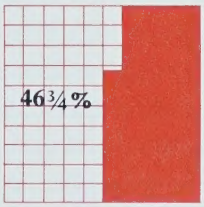
		1972	1971
DOLLAR SALES OF ALL PRODUCTS	United States Operations		
	Automotive products	**$23,894,834,000**	$22,619,113,000
	Nonautomotive products	**1,705,176,000**	1,560,884,000
	Defense and space	**321,907,000**	414,617,000
	Total United States Operations	**25,921,917,000**	24,594,614,000
	Canadian Operations	**2,489,082,000**	2,470,395,000
	Overseas Operations	**4,741,467,000**	4,112,314,000
	Elimination of Intercompany Sales	**(2,717,235,000)**	(2,913,405,000)
	Total	**$30,435,231,000**	$28,263,918,000
FACTORY SALES OF CARS AND TRUCKS	Manufactured in U.S. plants	**5,741,000**	5,767,000
	Manufactured in Canadian plants	**459,000**	509,000
	Manufactured in Overseas plants	**1,591,000**	1,503,000
	Total	**7,791,000**	7,779,000
NET INCOME	**Total**	**$ 2,162,807,000**	$ 1,935,709,000
	As a percent of sales	**7.1%**	6.8%
	Earned per share of common stock	**$7.51**	$6.72
	Dividends per share of common stock	**$4.45**	$3.40
TAXES	United States, foreign and other income taxes	**$ 2,059,800,000**	$ 1,784,100,000
	Other taxes	**917,900,000**	775,900,000
	Total	**$ 2,977,700,000**	$ 2,560,000,000
INVESTMENT AS OF DECEMBER 31	Working capital	**$ 5,564,775,000**	$ 4,530,387,000
	Stockholders' equity	**$11,682,879,000**	$10,805,237,000
WORLDWIDE EMPLOYMENT	Average number of employes	**760,000**	773,000
	Total payrolls	**$ 8,668,224,000**	$ 8,015,072,000

WHAT HAPPENED TO THE REVENUE GM RECEIVED DURING 1972

GM RECEIVED

From sale of its products and other income
$30,610 million

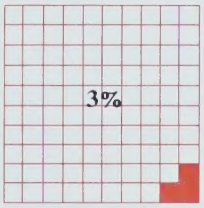
THIS REVENUE WENT



To suppliers for materials, services, etc.
$14,309 million

To employes for payrolls, employe benefit plans, etc. **$10,248 million**

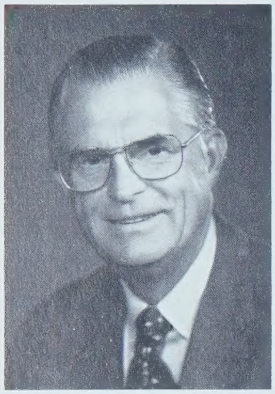
To Federal, state and local governments for taxes
$2,978 million



To provide for depreciation and obsolescence of real estate, plants and equipment
$912 million

To GM stockholders
$1,286 million

For use in the business to provide for expansion and modernization of facilities and for working capital
$877 million



RICHARD C. GERSTENBERG

EDWARD N. COLE

This report on General Motors in 1972 is one of performance and progress. The year saw new records in sales and earnings, as well as steady advances toward meeting the environmental and social objectives of our times. The satisfaction that the General Motors organization feels in these achievements is tempered by the realization that there is still a long way to go before our performance in every respect equals that of our past, and our progress meets the requirements of our future.

The sales curves for General Motors continued upward in 1972. Car and truck sales throughout the world were at a record for the second consecutive year. Earnings per share edged to a new high, but the margin of profit to sales, while slightly higher than in 1971, was well below that of other years. The lag of profit increases behind rising production costs and added investment was a significant consequence of inflationary costs and governmental price controls.

Phase III of President Nixon's economic program is welcome as a move toward a free economy. Yet the present restraints on pricing action, while somewhat less than mandatory, are hardly less obligatory. The nation's interest and the continued threat of inflation impose a special responsibility upon General Motors. We have publicly endorsed and are supporting the President's program even though cost inflation is still affecting General Motors. It should be remembered that we have had no price increases on our cars and trucks since early 1972, other than the pass-through of the bare costs of safety and emission-control equipment added to meet governmental standards. This increase, amounting to 1.2% on the average car, became effective December 4.

In September, our contracts with the major unions representing our employes in the United States will expire. Management regards this expiration as a timely opportunity to encourage the nation's economic growth by achieving an equitable and non-inflationary agreement without any loss of production. We hope the leadership of labor also will see it as such. We are concerned with the public statements of labor leaders which call for increased wages and new benefits in a wide range of important areas. We hope, as we approach the negotiations, that these will be adjusted to the necessities of our times so that an agreement that is fair to all can be reached without a strike, which would be so disruptive to the lives of our employes and so costly in terms of productive resources.

A less apparent but no less serious waste of manpower and capital resources is occurring daily as GM and the other automobile companies race to develop and manufacture the equipment to meet governmental standards for emission control and passenger protection, many of which are excessively stringent.

While everyone favors cleaner air and greater highway safety, there is reason to question whether the standards provide benefits to the consumer that are commensurate with their costs. General Motors alone is preparing to spend nearly $1 billion this year to meet the safety and emission standards. To the extent that their benefits to society fall short of their costs, the standards in effect mandate a waste of productive resources. General Motors must neverthe-

less continue to seek their achievement, and we are making demonstrable progress, expensive and painstaking though it is. We must proceed, at least in the case of emission control, without the assurance that the difficult and still administratively undefined standards for 1975 and 1976 vehicles can be achieved in the brief time remaining. The assurance we need can be gained only from adequate testing and field experience, and this takes time.

Last year, we and the other automobile companies applied to the Environmental Protection Agency for a one-year suspension of the 1975 emission standards which the Clean Air Act allows it to grant. This was denied, but on February 10, 1973, the Federal Circuit Court of Appeals for the District of Columbia directed the EPA to reconsider our application. We will, in any case, apply to the EPA for a year's suspension of the 1976 emission standards, and will continue to seek an early and necessary clarification of the standards and testing procedures for both 1975 and 1976. We are also urging that the Clean Air Act be amended to bring the standards into line with the nation's air-quality needs. Meanwhile, we will continue to work with the government so that regulation may be administered with a more balanced regard for the economy and the ecology, and with a more careful consideration of the inevitable cost to the consumer.

General Motors sees an important part of its future in the rapidly growing overseas market. To enable the Corporation to gain access to growth opportunities in other parts of the world, GM is participating in new automotive ventures in several countries, notably Japan, Thailand, the Republic of Korea, Zaire and the Philippines.

The realization of these overseas opportunities depends to an important degree on the ability of General Motors and other American business enterprises to trade and invest throughout the world without undue restrictions. Protectionist measures like the Burke-Hartke Bill would impose severe limitations on international trade and direct investment overseas. The evidence is clear that the operations of American multinational companies have not resulted in a net loss of employment and payrolls in the United States. Import quotas, limitations on further investment overseas and restrictions on the overseas use of American patents and licenses could cause trade retaliation by other countries at a time when our national purpose is to draw the nations of the world closer together. The economic result of such retaliation would be a decrease in American exports and a reduction in the flow of income to the United States.

General Motors in 1972 continued its efforts in other areas of public concern, and showed further progress in hiring, training and advancing women and minority employes, as well as in assisting minority enterprise.

We are also hard at work on the problems presented by the much-discussed national energy crisis. General Motors has developed, and is now installing in our Cleveland Chevrolet plant, a system which we think will enable us to burn coal—our most abundant energy resource—with fewer of the polluting effects

previously encountered in the use of coal. If this system proves out, it holds promise of important benefits to General Motors and all industry in the energy-hungry years that appear to be ahead.

Because our cars and trucks are significant users of the nation's fuel supplies, our long-range product planning must consider the possibility of future shortages of available energy. Fuel conservation is becoming an even more important design criterion as we plan the automobiles and trucks that we will build and sell in the late Seventies.

For 1973, the outlook for the entire automotive industry, and for General Motors in particular, continues to be favorable. As the economic situation continues to improve, the demand for GM products is expected to remain strong. Industry sales in the United States of 11 to 11.5 million passenger cars, including imports, are a reasonable expectation, with American-built cars again accounting for most of the increase over 1972. Truck sales, even after the exceptional surge in 1972, could well reach 2.75 million units. The rising demand for trucks for recreational use and the introduction of many new special-purpose vehicles are distinctive features of this market. Car and truck sales together then could set another industry record in 1973—reaching an all-time high in the area of 14 million units.

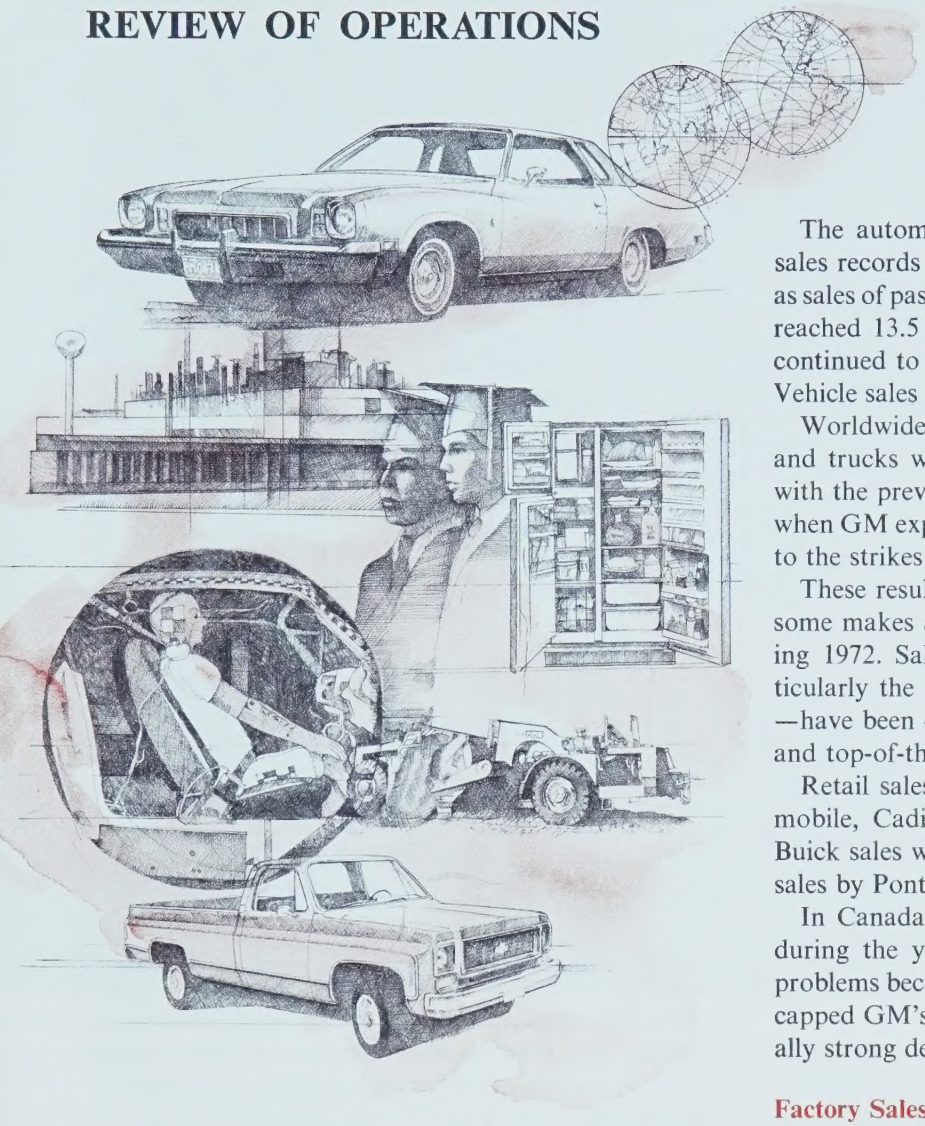
With respect to earnings, much will depend on GM's ability to recover cost increases through improved efficiency and price adjustments. We are projecting capital expenditures of well over $1 billion in 1973, which would make this the fifth consecutive year when capital spending approached or exceeded this amount. Much of this investment is to modernize our equipment so we may better compete in the growing markets both here and abroad. All such investments and all of management's efforts to improve efficiency are, of course, wiped out when our operations are closed down by strikes—a fact of special significance in 1973 because of the expiration of our current union contracts in September.

In the final analysis, GM's progress during 1972 was due primarily to the continued loyalty of its customers, the diligent efforts of General Motors employes throughout the world, the excellent performance of GM dealers and suppliers and the consistent support of those who own the business, the General Motors stockholders. We take this opportunity to extend to all of you our sincere gratitude and to acknowledge that our performance and progress in 1973 are also dependent upon you.

This report is prepared and submitted to the stockholders of General Motors by order of the Board of Directors.

E. M. Cole
PRESIDENT

R. C. Gerstenberg
CHAIRMAN



The automobile industry in the United States set sales records for the second consecutive year in 1972, as sales of passenger cars and trucks, including imports, reached 13.5 million units. United States truck sales continued to be exceptionally strong during the year. Vehicle sales overseas also reached new highs.

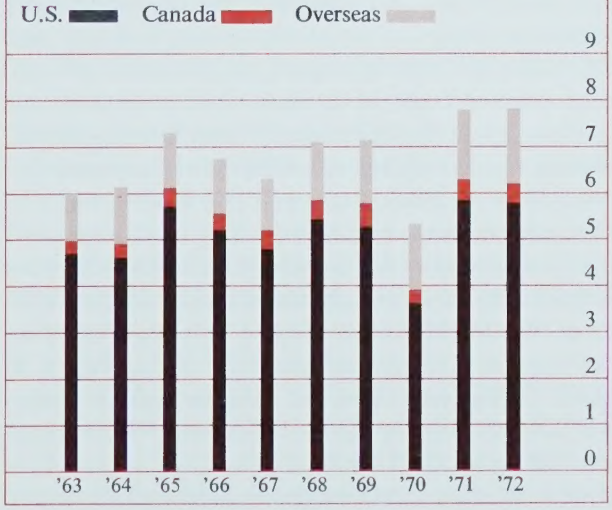
Worldwide factory sales of General Motors cars and trucks were a record 7,791,000 units, compared with the previous record 7,779,000 units sold in 1971, when GM experienced added production and sales due to the strikes in the U.S. and Canada in 1970.

These results were achieved despite the shortage of some makes and models because of local strikes during 1972. Sales of General Motors 1973 cars—particularly the completely restyled intermediate models—have been excellent, as has the demand for options and top-of-the-line models.

Retail sales highs were posted by Chevrolet, Oldsmobile, Cadillac and GMC Truck & Coach, while Buick sales were the second highest in its history and sales by Pontiac were up 7% from 1971.

In Canada, demand for General Motors products during the year was excellent, although availability problems because of strikes in the United States handicapped GM's ability to capitalize fully on this unusually strong demand.

GM Worldwide Factory Sales—Cars and Trucks
millions of units



Factory Sales of Cars and Trucks in the U.S.

Industry factory sales of cars and trucks produced in the United States totaled a record 11,271,000 units in 1972, 6% above the 10,638,000 units sold in the previous year, and 2% above the previous all-time high of 11,057,000 units set in 1965.

Factory sales of General Motors cars and trucks produced in the United States totaled 5,741,000 units in 1972, compared to the all-time high of 5,767,000 units set in 1971 and 5,696,000 units in 1965.

Sales of Nonautomotive Products

General Motors sales of commercial nonautomotive products in the United States in 1972 totaled $1.7 billion, 9% above sales in the previous year.

Detroit Diesel Allison Division established record sales of its heavy-duty diesel engines in 1972. This achievement demonstrates the increasing demand for the Division's diesel engine line and the significant growth of the trucking industry in the U.S. Also during the year, the Division introduced four completely new automatic transmissions, making it the nation's first

supplier of a full line of automatic transmissions for medium- and heavy-duty trucks. This new line, which includes five basic models, offers the truck user the highest degree of performance, safety, reliability and overall operating economy.

GM's TEREX Division introduced on July 1, 1972, a totally new line of large haulers for worldwide distribution. This re-entry into the hauler line, after a lapse of four years, as permitted under the terms of a consent decree, represents extensive planning and engineering effort. Four models—the 28-ton, 40-ton, 55-ton and 80-ton classes—will be manufactured in the United States. A fifth class—a 150-ton capacity unit—is being built by the Diesel Division of General Motors of Canada Limited.

In 1972, Electro-Motive Division's total sales volume reached a new high, marking the second consecutive year of record-breaking sales performance. With the increased emphasis being placed on improved modes of mass transportation, the Division has launched an intensive development program on a self-propelled rail car and expects to build four prototype commuter cars. In Canada, sales of diesel-electric locomotives by the Diesel Division of General Motors of Canada Limited were also at record levels for the second consecutive year.

Frigidaire Division's appliance operations achieved a major turnaround in 1972. In recent years, appliance operations at the Division have been adversely affected by the higher wages and benefits paid to its employes when compared with employes of competitive manufacturers. The amendment to the labor agreement between GM and the International Union of Electrical, Radio and Machine Workers in the latter part of 1971 waived certain contractual conditions. Frigidaire has embarked on an extensive national advertising campaign, implemented a variety of innovative marketing programs and expanded its existing product lineup. These activities have brought about favorable results, and the Division has rehired employes on layoff at the time the new contract was signed with the IUE.

Canadian Operations

Factory sales of GM vehicles produced in Canada totaled 459,000 units in 1972, compared with 509,000 units in 1971. In 1972, General Motors of Canada Limited sold 172,000 vehicles imported from GM plants outside of Canada and exported 255,000 vehicles built in Canada for sale in the United States.

Sales by GM of Canada in 1972, expressed in U. S. dollars, totaled $2.5 billion, slightly higher than the 1971 record.

General Motors Overseas Operations

General Motors established unit and dollar sales records outside the United States and Canada in 1972. Factory sales of 1,591,000 passenger cars and commercial vehicles produced overseas, together with sales of 81,000 exports from the United States and Canada, totaled 1,672,000 units, 5% above the previous record of 1,592,000 units set in 1971. In 1972, total sales of all products overseas amounted to $4.7 billion, a 15% increase over the $4.1 billion established in the preceding year.

Expenditures for Plant and Equipment

During 1972, General Motors spent $940 million for new plants and equipment and the modernization of existing facilities throughout the world. Of this total, 80% was spent in the United States.

Extensive modernization and expansion of assembly and fabricating facilities in Lansing, Michigan, was announced by Oldsmobile and Fisher Body Divisions.

Two projects to provide increased manufacturing capacity for on-highway heavy-duty truck diesel engines were announced by Detroit Diesel Allison Division during 1972, and Packard Electric Division began construction of a manufacturing plant near Jackson, Mississippi.

A number of projects to further control industrial pollution were underway in 1972. Chevrolet Division began construction of waste-treatment facilities at plants in Massena and Tonawanda, New York, and Livonia, Michigan. Delco Electronics Division announced plans for expansion of waste-treatment facilities at two plant sites in Kokomo, Indiana, and GM Assembly Division began construction of air-pollution control facilities at plants in Lordstown and Norwood, Ohio. In LaGrange, Illinois, Electro-Motive Division began building an industrial-waste sewer system to allow separation of storm and waste sewage.

In addition to these new programs, work continued during 1972 on oil-waste treatment facilities at Cadillac Division in Detroit; foundry air-pollution control facilities at Pontiac Motor Division in Pontiac, Michigan; a central waste-treatment plant at GMC Truck & Coach Division in Pontiac; and industrial waste-treatment facilities at Delco Moraine, Fisher Body and GM Assembly Divisions.

Several divisions, including Buick Motor, GMC Truck

CHEVROLET CAPRICE Classic Four-Door Sedan

& Coach, Oldsmobile and Fisher Body, made sizable expenditures in 1972 on continuing projects for modernization of electrical power equipment. The installation of new electrical power equipment in the General Motors Building in Detroit also continued in 1972.

In Canada, expenditures were made to convert the Ste. Therese, Quebec, assembly plant to Vega production, and to expand nodular iron capacity and reduce foundry emissions at St. Catherines, Ontario. Conversion to intermediate-size passenger car capacity at Oshawa, Ontario, was underway in 1972.

Overseas, Adam Opel is expanding vehicle-manufacturing capacity for Opel passenger cars and has begun an expansion of parts and accessory warehouse facilities at Ruesselsheim, Germany. In Brazil, expenditures were made in 1972 to increase production of the Opala passenger car line and to manufacture a smaller car to be introduced in 1973.

General Motors also began construction of facilities to assemble and eventually manufacture TEREX earthmoving equipment in Brazil. Scheduled for completion in mid-1974, the manufacturing plant will be located on a 75-acre site near the city of Belo Horizonte, approximately 300 miles north of Rio de Janeiro. The operation will produce off-highway earthmoving equipment for construction, mining, logging and industrial applications.

Expenditures are being made by General Motors Zaire S.A.R.L. in Africa to establish facilities in Kinshasa, Zaire, for the assembly of GM vehicles and in South America by General Motors Argentina S.A. to provide for the production of an additional line of passenger cars smaller than the Chevrolet models currently manufactured.

Research Activities

In connection with an expansion of the Research Laboratories recommended by GM's Science Advisory Committee, work began on development and construction of a 100,000-square-foot building at the Technical Center in Warren, Michigan. To handle its personnel requirements, the Environmental Activities Staff was consolidated in its new building at the Technical Center. The Engineering Staff plans construction of an

PONTIAC GRAND AM Colonnade Hardtop Coupe

automotive wind tunnel at the Technical Center.

In 1972, General Motors spent $880 million for research, product engineering and development activities related primarily to the development of new products or services or the improvement of existing products or services, including activities related to vehicle emissions-control and the safety of persons using GM products. In 1971, this amounted to $839 million.

Automotive Safety

General Motors continues to make substantial expenditures to improve the operational safety of its vehicles and the protection provided their occupants. Expenditures in the United States in 1972 for automotive safety totaled $507 million. This included engineering, research, reliability, inspection, testing, facilities and tools.

Compliance of 1973-model vehicles with the new motor vehicle safety standards on interior flammability and exterior protection (bumpers) required extensive development. New test procedures for this purpose had to be instituted, people trained at key locations in the Corporation to conduct them and compliance tests run. Such efforts also had to be extended to the many vendors in support of these activities.

In June 1972, GM turned over to the U.S. Department of Transportation (DOT) five Experimental Safety Vehicles (ESV) built by General Motors as a public service. As defined in DOT contract specifications, emphasis was upon occupant-protection and accident-avoidance capability and cost was not a major consideration.

Primary emphasis was placed on passive occupant protection in a 50 mph barrier crash. While GM is proud of these experimental vehicles, it believes a 50 mph impact goal may be excessive and impractical, as it results in a very heavy vehicle that is too costly to build and too expensive to operate. However, despite the many problems associated with the development of the ESV, valuable experience has been gained by this challenging assignment.

General Motors is continuing its efforts to develop restraint systems that will meet Federal safety standards for occupant protection. To fulfill the 1974 requirements, GM is working on a new belt restraint

OLDSMOBILE CUTLASS SUPREME Colonnade Hardtop Coupe

system with starter interlock which would prevent the car from starting until the driver and front seat occupants buckle up.

At the same time GM is continuing its work on air cushions. As part of the testing and development of the air cushion, General Motors has built one thousand 1973-model Chevrolet cars with an air cushion restraint system. About 50% of these cars are in use by General Motors employes in the field and the remainder are being placed in commercial fleets. The cars are being carefully placed around the country so that the evaluation will reflect a balance of climates and driving environments. Each of these vehicles is being monitored on a scheduled basis and a complete technical investigation will be made of any accidents resulting in significant damage to the vehicle. If the results of this test fleet prove satisfactory, and assuming that the Federal safety standards for occupant protection will be altered to permit the use of air cushions for the 1974 model year, present planning calls for air cushions to be available as an option on some of the 1974 models.

The status of the Federal occupant crash protection requirements was greatly affected by the U.S. 6th Circuit Court of Appeals ruling that the injury measurement aspects of the 1974-1976 occupant crash protection standard could not go into effect until specifications for an adequate test dummy are completed. In line with this, General Motors, and another company, are developing an improved test dummy under contract to the DOT.

In an effort to help solve the problem of the drinking driver, GM recently announced the experimental Critical Tracking Task (CTT) system. The system utilizes the car's steering wheel, and requires the driver to pass a 10-second test in which he must control the movement of a needle on the instrument panel dial before he can start his car. The CTT thus far holds promise of being more effective in immobilizing the cars of intoxicated drivers than any other experimental automotive interlock tested or developed by GM.

In its continuing search to improve upon current technology, GM is exploring refinements to the traditional bumper concept. One of these, still highly experimental, is a "soft face" bumper composed of cushioning materials plus a tough plastic exterior facing to absorb the impact. The "soft face" concept

OPEL COMMODORE GS/E

HOLDEN KINGSWOOD SEDAN

VAUXHALL VENTORA

acts as a bumper system and more effectively manages energy during low-speed impacts. One GM experimental vehicle has been subjected to more than 100 impacts in the 5 mph range, including barrier, pole, pendulum and car-to-car impacts, without apparent damage.

Automotive Air-Pollution Control

During 1972, General Motors spent $238 million on making emission controls more efficient and effective, on research to develop new emission-control systems and for related facilities and tooling. General Motors now has the equivalent of 4,000 scientists, engineers, technicians and supporting staff committed to the task of removing the automobile from the air-pollution problem.

GM's 1973 models include emission-control devices that reduce emissions from the carburetor, crankcase and fuel tank. The formation of exhaust emissions is also minimized through better control of the combustion process. This includes more accurate fuel metering, spark timing and air temperature control.

The 1970 amendments to the Clean Air Act call for extremely stringent controls on the levels of emissions for 1975 and 1976 models. General Motors has been able to meet these emission levels, but only with prototype systems in experimental cars. Much more progress in technology is required before these carefully tuned experimental systems can be mass-produced so that each car not only meets the Federal guidelines, but also functions properly in the hands of customers over the time and mileage period required by the legislation.

The Clean Air Act requires that 1975-model vehicles must maintain the low emission levels for five years or 50,000 miles. Yet the manufacturer has not been allowed adequate time to test the control system under all the various field conditions, all the differences in driving patterns, altitude, temperature and humidity, which will be encountered in five years or 50,000 miles. These durability requirements place undue risk and unfair responsibility on the manufacturer, especially when consideration is given to the warranty liability and potential recalls on such a complex system, which is still to be tested.

Of vital importance is the matter of "averaging" of emissions during testing. The objectives of the Clean Air Act will be satisfied when the average car, rather than each and every car, meets the standards. Because prototype certification cars are individually constructed to represent the intended mean limit of the production car, the interacting effects of many variables—each controlled within close tolerances—make it impossible to obtain exactly the same emission levels from each production car. These small individual component and adjustment differences are an inherent characteristic of mass-produced products, and must be recognized in setting standards.

While GM is making every effort to meet the

BUICK CENTURY Colonnade Hardtop Coupe

standards, it believes they are unrealistic and unwarranted. The automobile industry requested a one-year suspension of the 1975 standards. This request was denied by the Environmental Protection Agency, but on February 10, 1973, a Federal Circuit Court of Appeals directed the EPA to reconsider the application.

If the manufacturers are granted the lead time they need and the allowance for averaging, their efforts to meet the objectives of the Clean Air Act can go forward on a more orderly and efficient basis. The individual car buyer, as well as society as a whole, will therefore benefit. Meanwhile, General Motors also will continue to make every effort to develop and test these advanced control systems. While this work is going on, GM will continue to seek appropriate modifications and interpretations of the law.

Even if the emission controls GM is now developing do not meet the 1975 and 1976 requirements as now written, GM believes that these controls will effectively solve the automobile air-pollution problem.

Despite the millions of pre-control cars still on the road and the increase in the total number of motor vehicles, the industry has turned the corner on automotive air pollution. The Third Annual Report of the President's Council on Environmental Quality points out that air pollution from motor vehicles continues to decline nationally. In addition, other qualified sources confirm that there has been a major improvement in air quality.

GM is working aggressively on many systems to achieve the emission-control improvements required by the Clean Air Act. Catalytic systems currently appear to have the greatest potential to meet the 1975 emission standards. A catalytic system acts chemically to convert pollutants into harmless elements as the automobile's exhaust gases are passed through it.

The search for catalysts has assumed worldwide proportions. Fifty-one different chemical firms have developed and submitted 971 catalysts, but few catalysts have survived the rigorous test program with low enough emission levels to assure compliance.

CHEVROLET FLEETSIDE Pickup and Series 50 Stake *GMC Series 9500 Diesel*

These few catalysts have employed platinum and palladium to achieve the necessary durability and efficiency on experimental vehicles. Because of this, General Motors and Impala Platinum, Ltd. in South Africa have entered into a long-term purchase and sale agreement whereby Impala will supply GM with specified amounts of platinum and palladium.

GM Experimental Safety Vehicle

General Motors is also continuing research into the gas turbine, electric, electric-hybrid, and stratified-charge power plants. However, each presents development problems. Not only emission standards, of course, but customer expectations of efficiency, performance, durability and over-all cost must be met.

Rotary Engine Development

Engineering and development work on the rotary engine has proceeded to the point where a commitment has been made for limited manufacturing facilities and tools. In December 1972, General Motors made a third payment of approximately $10 million under its worldwide Wankel rotary combustion engine license agreement with Curtiss-Wright, Audi-NSU and Wankel G.m.b.H.

Ongoing design and development responsibility for the rotary engine has been transferred to Chevrolet from the Special Product Development Group. Engine development and manufacturing processing work will continue and, if this progresses as anticipated, public introduction of the engine may be made on a 1975 model in the small Chevrolet line. Initial engine production will be made at the Hydra-matic Division plant in Ypsilanti, Michigan.

Industrial-Pollution Control

General Motors is engaged in major efforts to substantially reduce air and water pollution from its plants. The objectives of these efforts are to meet current codes and prepare for anticipated codes, prevent pollution problems by developing processes that do not pollute, conserve natural resources, develop and apply new technology and share its experience and technology with others.

During 1972, GM spent $58 million in the U.S. on the construction of additional pollution controls for its plants—not including the cost of operating and maintaining present facilities or funds earmarked for research into new pollution-abatement systems.

GM's commitment to clean water continued in 1972, with waste-water treatment facilities being completed at 18 locations and 34 new water treatment projects initiated during the year in the U.S. and Canada. Also, storm water retention lagoons were installed at four locations to treat all storm water and its accompanying oil and grit, including run-off from plant parking areas.

In-plant process changes to reduce pollution potential are also a part of the GM program. For example, significant changes were made at several locations during 1972, including changeover to acid-copper plating rather than cyanide-copper plating, and installation of cyanide-free zinc plating.

The three most critical sources of air pollution from plants are foundries, powerhouses and paint systems. GM was among the first to use high-energy Venturi scrubbers and collectors to remove as much as 98% of the dust particles from foundry operations.

To reduce emissions from paint systems, GM has developed a low-pollution primer paint process that uses a dip method involving a water-based paint, rather than spraying on a solvent-based primer. This system, already in operation at some plants, not only reduces emissions, but also provides an improved coating of paint. Current experiments are making progress in the development of a nonsolvent, nonpolluting powder paint process for the finish coat.

The Chevrolet plant in Cleveland, Ohio, is installing scrubbing equipment on its coal burning boilers to remove sulphur dioxide from the stack gases. A pilot plant tryout has been conducted to test the practicality of the scrubbers, which use sodium hydroxide as a cleaning agent. The system can reduce sulphur dioxide emissions by more than 90%, as well as reduce dust resulting from burning coal. Successful efforts to control sulphur dioxide could help ease the energy crisis facing this nation. Coal, our nation's most abundant fossil fuel reserve, could then be more widely used in powerhouses, instead of oil and natural gas, whose known reserves are being rapidly depleted.

New boilers being installed at GMC Truck & Coach Division in Pontiac, Michigan, are designed to attack solid-waste and air-pollution problems and, at the same time, utilize the heat for steam generation. The boilers are designed to burn solid combustible waste materials, as well as coal. In addition, wet scrubbers will also reduce particulate emissions from the boiler stacks.

Even though General Motors has consistently made substantial expenditures to meet or exceed existing Federal, state and local safety and health standards, compliance with the regulations of the Occupational Safety and Health Act of 1970 will require even greater expenditures in the next few years.

Noise Control

GM cars and trucks are being designed and manufactured to meet state and local laws relative to external pass-by noise level regulations. A major engineering development program is underway at General Motors to further reduce noise from GM's products to meet requirements projected for the future.

At the same time, General Motors is acting to control unwanted and intrusive sound in and from its plants. Engineering solutions are being sought to make machinery quieter and to eliminate unnecessary surrounding noise. Such solutions include a greater use of quieter tools, the enclosing of noise sources, the use of exhaust air silencers on machines and the use of impact cushions and padding.

Charitable Contributions and Aid to Education

General Motors believes that it has an obligation to make reasonable monetary contributions to local charitable, educational and community organizations in areas where it operates. Contributions other than for education are generally related to the size and employment of GM's operations in each particular locality. Nationally, General Motors contributes to organizations to which, as a large industrial enterprise, its participation would be appropriate.

During 1972, contributions to charitable organizations totaled $8.8 million. Many of these contributions were made to organizations working to stimulate economic opportunity and racial equality and to provide employment and housing for disadvantaged people. Nearly 90% of this total was donated to local organizations such as community funds, family-service groups, hospitals, youth organizations and minority-related groups in cities where GM has operations.

Financial aid to education by General Motors in 1972 totaled $8.6 million. This amount included $3.5 million of property and products donated by the

Corporation to educational institutions. The balance consisted of the General Motors Scholarship Programs; funding for cooperative education programs in minority colleges; a Graduate Fellowship Program for selected employes with high potential as well as individuals who held GM scholarships as undergraduates; research and engineering grants to universities and technical institutions; contributions to major university fund campaigns and support of special education projects.

The GM Scholarship Program is now benefiting 864 students in colleges and universities in the United States.

Board of Directors

During 1972, a six-member Nominating Committee was organized as a permanent standing committee of the General Motors Board of Directors. The Committee was established to conduct continuing studies of the size and composition of the Board of Directors and from time to time to make recommendations to the Board. Committee members, all of whom are outside directors, are: Eugene N. Beesley, Chairman; Lloyd D. Brace; John T. Connor; John A. Mayer; Howard J. Morgens; and Thomas L. Perkins.

The Board of Directors approved the following changes in the Board during 1972.

Six new members were elected to the Board of Directors. They were: Catherine B. Cleary, President, First Wisconsin Trust Company, Milwaukee, Wisconsin; Walter A. Fallon, President, Eastman Kodak Company, Rochester, New York; Charles T. Fisher, III, President, National Bank of Detroit, Detroit, Michigan; Harry Heltzer, Chairman, Minnesota Mining and Manufacturing Company, St. Paul, Minnesota; and Elliott M. Estes and Richard L. Terrell, Executive Vice Presidents, General Motors Corporation, Detroit, Michigan.

In addition, Dr. Leon H. Sullivan and Charles T. Fisher, III were elected members of the Audit Committee of the Corporation, increasing membership of the Committee to six, all of whom are outside directors. Other members are: J. Wesley McAfee, Chairman; Harllee Branch, Jr.; John A. Mayer; and W. Earle McLaughlin.

Two directors, Albert Bradley, former Chairman, Board of Directors, and John F. Gordon, former President, retired. Mr. Bradley and Mr. Gordon served General Motors with distinction for many years.

The membership of the General Motors Board now totals 28, of whom seven are officers of the Corporation.

Organization Changes

Harold G. Warner, Executive Vice President, was named Special Assistant to the President and will assist in administering operating policies of General Motors North American operations. Mr. Warner continues as a member of the Board of Directors and the Executive Committee.

Elliott M. Estes was elected Executive Vice President with jurisdiction over the Operations Staff, succeeding Mr. Warner. Mr. Estes becomes a member of the Executive Committee.

Richard L. Terrell, with jurisdiction over the Car and Truck and Body and Assembly Operations, was elected an Executive Vice President and a member of the Executive Committee.

Reuben R. Jensen succeeded Mr. Estes as Group Vice President with jurisdiction over Overseas Operations. This position continues under the general jurisdiction of the Vice Chairman.

John Z. DeLorean, Vice President, succeeded Mr. Jensen as Group Executive in charge of the Car and Truck Group; F. James McDonald, Vice President, succeeded Mr. DeLorean as General Manager of Chevrolet Motor Division; and Martin J. Caserio, Vice President, succeeded Mr. McDonald as General Manager of Pontiac Motor Division.

Alex C. Mair succeeded Mr. Caserio as General Manager of GMC Truck & Coach Division. Mr. Mair was elected a Vice President.

George R. Elges, a Vice President, succeeded Lewell N. Mays, now retired, as General Manager of Buick Motor Division. Robert D. Lund succeeded Mr. Elges as General Manager of Cadillac Motor Car Division and was elected a Vice President of General Motors.

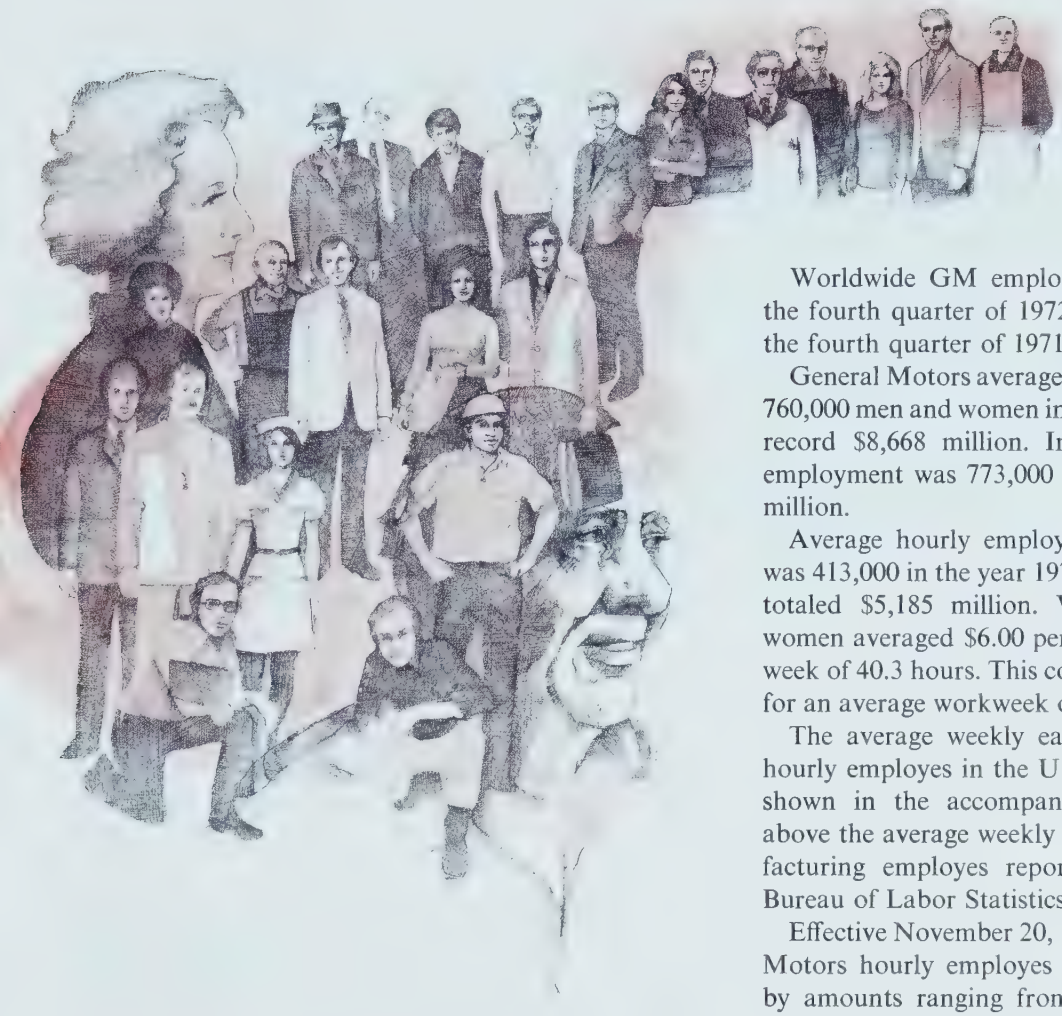
Robert W. Decker, formerly Vice President in charge of the Manufacturing Staff, replaced Robert L. Kessler as Vice President and General Manager of Fisher Body Division. Mr. Kessler, in turn, succeeded Mr. Decker as Vice President in charge of the Manufacturing Staff.

Harold L. Smith, Jr., was appointed General Manager of Electro-Motive Division and elected a Vice President of General Motors, succeeding Boyd B. Brownell, who retired under the provisions of the General Motors Retirement Program.

Howard H. Kehrl succeeded John B. Beltz, deceased, as General Manager of Oldsmobile Division and was elected a Vice President of General Motors.

Michael C. Meehan was appointed General Manager of United Delco Division, succeeding William M. Walker, Jr., who retired under the provisions of the General Motors Retirement Program.

Calvert Thomas, an Assistant General Counsel, was appointed Secretary of the Corporation, succeeding George W. Coombe, Jr., who continues as Assistant General Counsel with new responsibilities.



Worldwide GM employment averaged 796,000 in the fourth quarter of 1972 compared with 777,000 in the fourth quarter of 1971.

General Motors average worldwide employment was 760,000 men and women in 1972, and payrolls totaled a record $8,668 million. In 1971, average worldwide employment was 773,000 and payrolls totaled $8,015 million.

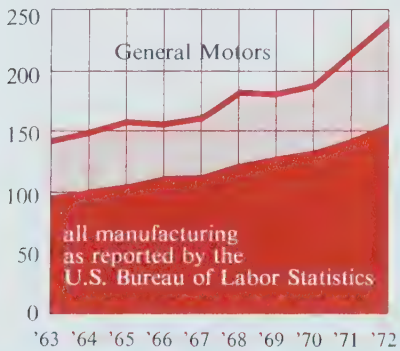
Average hourly employment in the United States was 413,000 in the year 1972, and U.S. hourly payrolls totaled $5,185 million. Wages for these men and women averaged $6.00 per hour for an average workweek of 40.3 hours. This compares with $5.57 per hour for an average workweek of 39.0 hours in 1971.

The average weekly earnings of General Motors' hourly employes in the U.S. in 1972 was $241.60. As shown in the accompanying chart, this was 56% above the average weekly earnings for all U.S. manufacturing employes reported by the United States Bureau of Labor Statistics.

Effective November 20, 1972, wage rates for General Motors hourly employes in the U.S. were increased by amounts ranging from 11 cents to 22 cents per

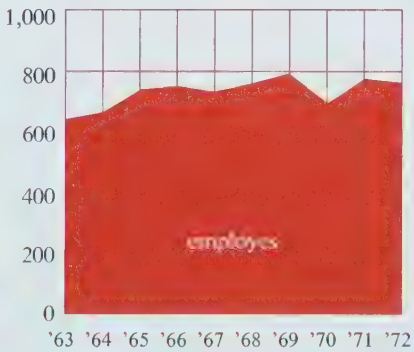
Average Weekly Earnings

Hourly Employes, U.S. dollars



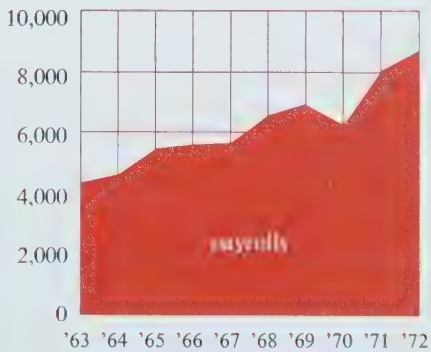
Worldwide Employment

thousands



Payrolls

millions of dollars



The hourly employes' dining rooms at Saginaw Steering Gear Division's seven plants in Saginaw, Michigan, provide for an attractive display of well-prepared food, comfortable surroundings and efficient traffic flow. All General Motors manufacturing facilities provide such eating areas for the convenience of employes.

Oldsmobile Division's Outdoor Club sponsors a professional rodeo, which is held each year at a fairground near its Lansing, Michigan, facilities. Profits are used to provide recreational activities for Oldsmobile employes and their families and to provide financial contributions to local charitable causes.

hour. This annual improvement factor is a result of GM labor agreements and policies. Such annual improvement factors have been provided to hourly employes since 1948. Effective December 4, 1972, the cost-of-living allowance for hourly employes in the U.S. was increased by three cents an hour, which brought the total cost-of-living allowance to 30 cents an hour.

On an annual basis, the average GM hourly employe's gross earnings before taxes are about $12,500. This does not include the cost of employe benefit programs, which have been significantly expanded over the years. The average annual cost to GM in the U.S. for payroll taxes and benefit programs per hourly employe is about $3,000, and includes such items as insurance premiums, pension contributions and social security taxes.

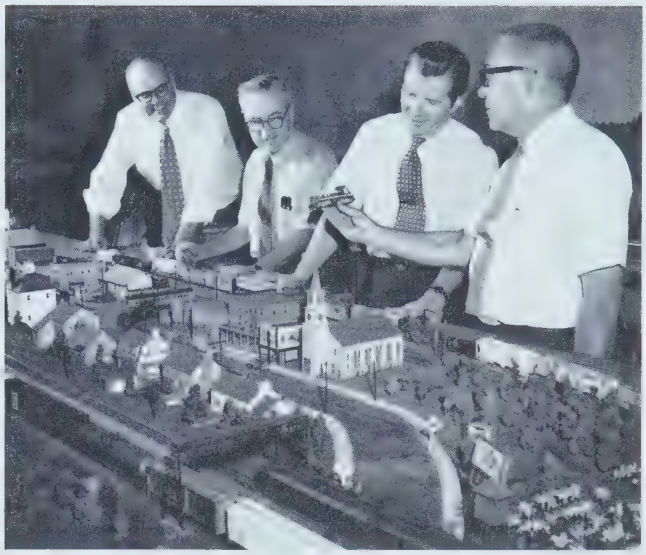
The average GM hourly employe works about 2,000 hours, including about 200 hours of overtime. Because this average employe has 12 years seniority, he receives 2½ weeks of vacation pay, plus five days of personal absence pay. GM hourly employes are eligible for a maximum vacation pay allowance of four weeks' pay for 20 years of service which, with five days of personal absence allowance, represents a total of five weeks. The average employe was paid for 12 holidays, which included the period between Christmas Eve and New Year's Day.

Further, if qualified, he was paid unemployment benefits during the summer of 1972 when he was laid off during the model changeover. These payments come from two places, but are financed by a single source—General Motors. He receives state unemployment benefits which are provided by the taxes that GM pays and supplementary unemployment benefits directly from General Motors. In a very real sense then, this average employe receives the equivalent of about seven weeks of pay for time he does not work.

General Motors continues to pay a laid-off employe's insurance premiums for up to 12 months. He is protected not only against layoffs, but, should he be sick or disabled, the average employe receives GM insurance benefits equal to $115 per week, most of which is tax free. He also remains covered by GM-paid life, hospital and medical expense coverages—the same as he received when he was working.

Under the current pension plan, such an hourly employe retiring today at age 56, with 30 years of

Delco-Remy Division's annual Employe Hobby Show attracted over 40,000 visitors in 1972. The event, held in the center of a 22,000 square foot area of one of the Division's Anderson, Indiana, plants, also features special displays on safety, pollution control, research, engineering and manufacturing technology.



Model railroading is a popular employe hobby activity at Electro-Motive Division. This layout at the Division's La Grange, Illinois, plant is spread over 1,500 feet of track. The Model Railroad Club, which is sponsored by Electro-Motive's Employe Activities Council, stages frequent exhibitions at the plant.

service, would receive retirement benefits of as much as $500 a month, or about $115 per week. With insurance premiums paid by GM, this represents an annual compensation of more than $7,000. If such an employe were to retire today at the normal retirement age of 65, with 39 years' service, he would realize a total retirement income, including his and his wife's social security and the GM-paid insurance premiums, of $9,600 a year.

Effective December 1, 1972, eligible salaried employes in the United States received 3% salary increases, ranging from $19 to $58 per month. In addition, the cost-of-living allowance for eligible salaried employes was increased from $135 to $150 per quarter effective December 1, 1972.

Equal Employment Opportunity

General Motors regards equal employment opportunity as both a moral and legal requirement, and is committed to the implementation of the Corporation's Equal Opportunity Employment Policy in every one of its plants and offices. That policy provides for an equal opportunity in employment and advancement for all, without regard to race, color, religion, national origin, age or sex.

This commitment can be demonstrated by the progress achieved during recent years in increasing minority participation in the General Motors work force. Minority employment has increased from 67,000 or 11.2% of the total General Motors U.S. work force in 1965 to 102,000 or 16.7% at the end of 1972, ranking General Motors as one of the largest private employers of minorities.

Progress has also been made in increasing minority participation in General Motors salaried and management ranks. Minorities in GM salaried positions increased from 1.7% in 1965 to 7.1% in 1972.

General Motors is also giving priority attention to increasing opportunities for the employment and advancement of women. As of December 31, 1972, General Motors employed approximately 85,000 women—2,800 of them in management, professional and technical capacities. A number of steps have been taken in this area, including recruiting at predominantly women's colleges, training women to become production supervisors or to qualify for other areas of management and surveying female employes for interest in advancement.

One of the difficulties in recruiting minorities and

women for these positions is that many of GM's salaried and management jobs require some engineering and technical training. Traditionally, however, few women or minorities have studied engineering. However, General Motors has actively recruited for a number of years at institutions with engineering curricula, including predominantly black colleges, in an attempt to increase employment of women and minorities in engineering jobs.

A number of steps are being taken by GM to help resolve this problem, and several of these involve General Motors Institute. Enrollment of women and minorities in the regular five-year co-op program has already been substantially increased. Last year, 372 minority students and 112 women were enrolled in General Motors Institute, and this number is expected to increase in the 1973 school year.

An experimental pre-freshman program has been established for scholastically qualified General Motors Institute applicants who were inadequately prepared for engineering studies in high school because of the lack of a proper curriculum and who otherwise might have been denied admission. Currently, 94 minority enrollees—including 14 women—are in this program, which is designed to provide students with training which will allow them to qualify for the regular engineering degree program.

Another step being taken is the development of a two-semester program at GMI to equip liberal arts graduates for technical employment in General Motors. Most of the 73 students who entered this program in the fall of 1972 are minority and women college graduates.

GM has established several programs to assist any employes who may not have completed their formal education. These include adult education programs to help employes who have not finished high school to pass high school equivalency tests.

Special emphasis is being placed on increasing the number of minority persons and women in the skilled trades. Pre-apprentice training programs at many GM plants develop the formal educational skills of prospective apprentices, and are designed to increase the number of these people who enter skilled trade apprenticeships.

In addition, GM actively participates in the National Alliance of Businessmen program for the hiring and training of disadvantaged persons. By the end of 1972, GM had hired approximately 68,000 people under this Corporation-funded program.

Business Goals and Human Needs

The history of General Motors is a story of success in anticipating and responding to change. Change in products comes first to mind, perhaps, since much of it is so readily visible.

Not always so quickly apparent is change in people—people who design, build and sell products as well as people who buy, use or are affected by them. Recognizing the inevitability of change in the backgrounds, attitudes, motivations and life styles of people—including its own—General Motors has initiated many people-oriented programs within the organization over the years. Their goal has been to combine people and the job to more effectively achieve GM's business goals, while at the same time recognizing the relationships between people and the importance of their changing needs and aspirations.

It became increasingly evident in recent years, however, that no single program aimed at isolated elements of the organization could achieve continuing, long-term improvement. General Motors needed a Corporation-wide awareness of the importance of all major aspects of the organization—such as the individual, the group, the situation, the task, the organizational structure and the technology.

These are all basic elements of what is called Organizational Development, a management concept which seeks improvements through changes in such areas as job content, supervisory relationships, organizational structures and the overall working environment.

One of the most significant projects in this relatively new field involved a pilot study by General Motors and the Institute for Social Research (ISR) of the University of Michigan. Initiated in 1969, this project marked the beginning of a long-range, scientifically-based program within General Motors. Four General Motors plants were involved. The project had two major goals—to seek long-term improvements in the human organization of General Motors, and to stimulate new concepts of managing people in a manner more consistent with the changing nature of the modern work force.

As a result of these activities launched or expanded throughout the Corporation and its divisions and staffs during recent years, increased emphasis is now being placed on several major objectives. Included are improved and broadened training activities, more effective employe-management communications and greater employe involvement and participation.

At many General Motors plants and facilities,

for example, an hourly employe is assigned to assist each production foreman with his nonsupervisory functions. Through this program, the foreman can spend more time managing his work group and providing more personalized leadership to his people.

GMC Truck & Coach Division is experimenting in a very limited way with group assembly concepts in building motor homes in its Pontiac, Michigan, plant. This involves teams of employes doing a variety of jobs in completing major parts of the vehicle—such as body and chassis—as opposed to the typical auto assembly line where each employe specializes in only a few operations. While emphasizing that the team approach appears to have potential only with very low-volume, specialized types of assembly work, GMC Truck & Coach officials believe this and other experimental projects may provide a means of increasing employe motivation and satisfaction.

The use of surveys to measure employe attitudes and organizational effectiveness has significantly increased. Surveys are also being used to solicit ideas and suggestions from employes.

Organizational Development activities are undergoing steady expansion with the coordination and assistance of the Personnel Administration and Development Staff. By the end of 1972, more than 80 divisional and staff Organizational Development specialists were working in 40 GM plants in the United States, Canada and several overseas subsidiaries.

General Motors believes potential benefits may be realized in such areas as improved quality, lower scrap losses, reduced absenteeism, reduced labor grievances, better overall operational performance and improved employe morale.

GM Employe Benefit Programs

In 1972, GM contributed a record $1.5 billion to employe benefit programs in the U.S. These programs offer hourly and salaried employes in the U.S. help in planning for the future and in providing security for themselves and their families.

The most comprehensive benefit program provided by GM is the Insurance Program. In 1972, the cost of this program alone amounted to more than $775 million. The program covers GM employes against a number of contingencies. It provides income protection in the event an employe is unable to work because of illness. Extended disability benefits may also be provided if the employe becomes totally disabled. Substan-

General Motors facilities have well-equipped, modern medical departments such as this one at Fisher Body Division's headquarters in Warren, Michigan. They are staffed by doctors, nurses and medical technicians who, in addition to providing medical services, cooperate with other plant personnel to insure that manufacturing areas provide a healthy environment.

Delco Moraine Division's Quarter-Century Club, comprised of active and retired employes with 25 or more years of service with the Division, meets annually to honor new members. In 1972, more than 900 active or retired employes were members of the club.

tial benefits—often full payment—are also provided when an employe or his eligible family members incur hospital, surgical, medical or prescription drug expenses.

In the event of an employe's death, the Insurance Program provides life insurance benefits of up to twice the employe's annual base pay. In addition, a substantial monthly benefit may be payable to an employe's surviving spouse. Salaried employes may also purchase optional group life insurance for up to three times their annual base salaries by paying the full amount of the premium.

The Pension and Retirement Programs are also of major importance to GM employes. The programs provide monthly retirement benefits for eligible employes who have reached retirement age or become totally and permanently disabled. Eligible surviving spouses may also receive lifetime benefits under these programs. At December 31, 1972, approximately 124,000 former employes or their survivors in the United States were receiving benefits amounting to $30 million each month under these programs. In 1972, the Corporation contributed almost $600 million to the U.S. Pension and Retirement Programs.

GM also provides three plans which minimize the effect of a layoff. Hourly employes are covered by either the Supplemental Unemployment Benefit Plan or the Income Security Plan. These plans provide a source of weekly income to supplement state unemployment compensation and also provide lump sum separation payments. Salaried employes are protected under the Separation Allowance Plan. General Motors contributed nearly $100 million for these plans in 1972.

The General Motors Savings-Stock Purchase Program provides eligible salaried employes with a sound and convenient system for saving. All salaried employes in the U.S. and Canada with more than one year of service are eligible to participate. An employe may save up to 10% of his base salary and cost-of-living allowance. For each $2 the employe saves, General Motors contributes $1. In 1972, 89% of eligible salaried employes in the United States saved an average of 8% of their salaries. There were 80,950 employes in the class of 1967 when it matured at the end of 1972, and they received or were credited with GM common stock, Government securities and cash valued at more than $132 million, the equivalent of $1.99 for each $1 they had invested in the program. The cost of the savings program to GM in 1972 was $61 million.

The year 1972 marked the 30th anniversary of the

Hydra-matic Division has 12 vending machine areas located throughout the manufacturing floor where employes can obtain quick food service items.

At Guide Lamp Division's annual Junior Firemen's Day, children who attend sign a pledge promising to observe the basic rules for reducing the hazards of fire.

General Motors Suggestion Plan. During the year, more than $13 million was awarded to employes in the U.S. for nearly 167,000 suggestions adopted under the plan. Of the suggestions adopted, 74 received the maximum award of $10,000.

Benefit plans in Canada are similar to those in effect in the United States. Plans at overseas locations vary and are in accord with local custom.

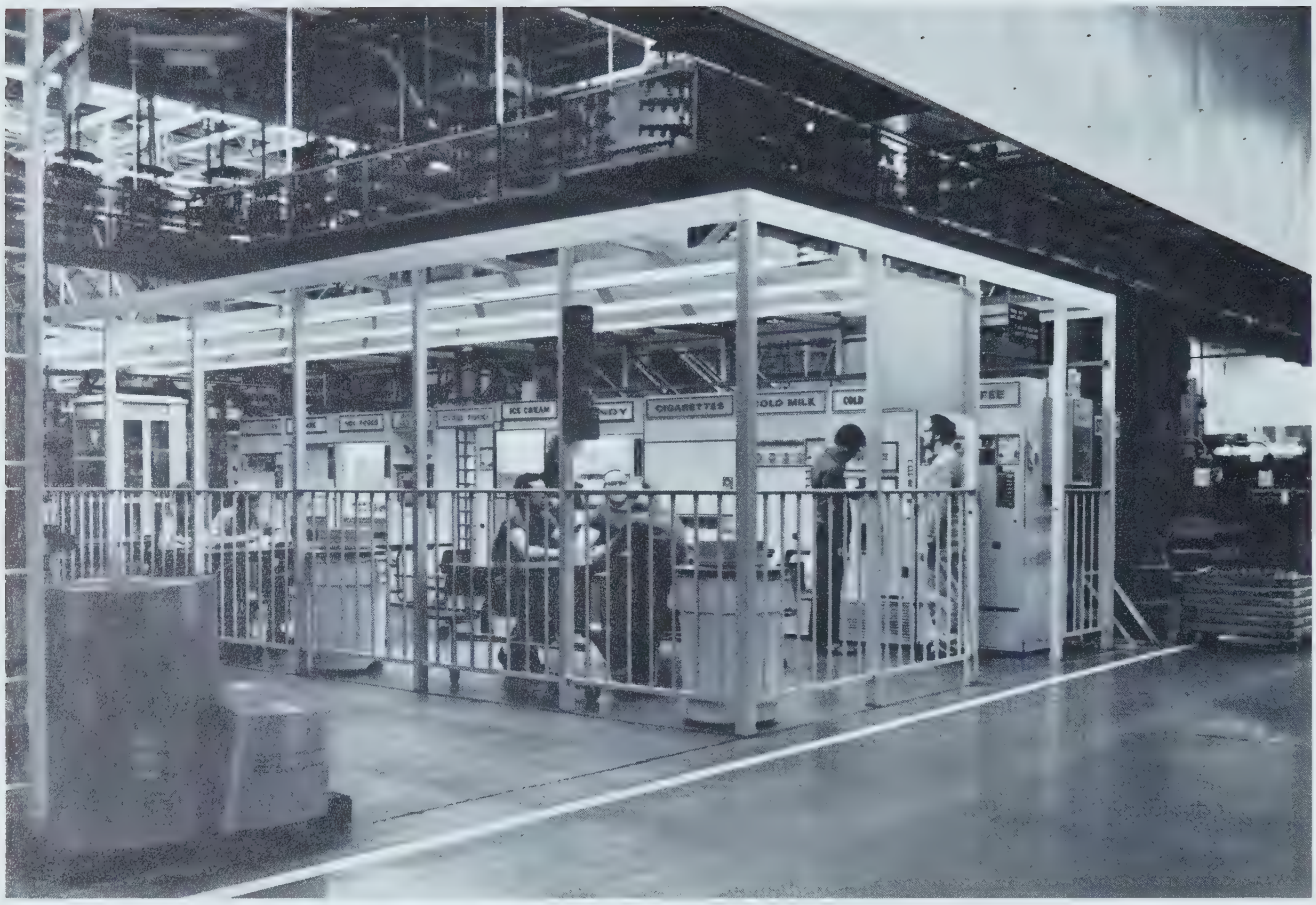
Educational Aid for GM Employes

General Motors believes that progress, whether economic or social, depends upon a steady influx of new knowledge and productive minds. To this end, General Motors, in addition to its support to higher education and the GM Scholarship Program, encourages participation by employes in the General Motors Tuition Refund Plan. Under this plan, GM reimburses employes in an amount up to $500 each year for the satisfactory completion of approved courses related to their field of work in recognized educational institutions. In 1972, employes studying under the plan were awarded 243 bachelor degrees and 161 graduate degrees. Refunds under the plan and individual graduate fellowships granted to employes by General Motors in 1972 totaled $2.9 million.

General Motors also maintains General Motors Institute, a fully-accredited college in Flint, Michigan. GMI, with an enrollment of more than 3,000 students, provides an opportunity to earn degrees in engineering and industrial administration through a cooperative program. Students alternate periods of academic study and paid work assignments related to their studies at sponsoring GM divisions. The Institute also conducts a wide range of part-time management and continuing education courses for employes of GM units. In 1972, expenditures for GMI were $10.3 million.

Incentive Program

The Incentive Program consists of the General Motors Bonus Plan and the General Motors Stock Option Plan and is administered by the Bonus and Salary Committee of the Board of Directors. The Committee has not yet determined the number of participants who may be awarded bonuses or granted stock options related to the year 1972. The computation of the maximum amount which may be credited to the reserve maintained for purposes of the Incentive Program is shown on page 38.



At Saginaw Steering Gear Division, rest areas are located throughout the manufacturing area for the relief period comfort and convenience of employes.

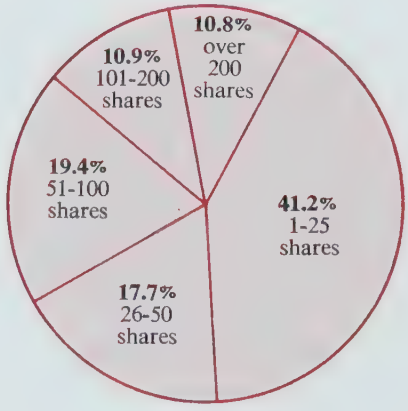
General Motors Stockholders

General Motors was owned by 1,285,000 stockholders at the end of 1972. They live in every state of the United States, in each of the Canadian provinces and territories and in more than 90 other countries.

At the end of 1972, 69% of the preferred and common stockholders were individual accounts, 20% were joint tenant accounts and 11% were institutions and groups, such as colleges, pension funds and insurance companies. Of GM's owners, 41% own 25 shares or less and 78% own 100 shares or less.

A Dividend Reinvestment Plan, which provides a convenient, economical method for GM stockholders to purchase additional shares through the automatic reinvestment of their dividends, was implemented in 1972. Thus far, approximately 102,000—or about 8%—of GM's stockholders have elected to participate.

Common and Preferred Stockholders by Size of Holdings



The past twenty-five years have seen a growing economic trend toward worldwide business operations. General Motors has participated in this worldwide economic development, which has been beneficial to all concerned. The industrialized nations have experienced an economic growth over the past quarter century that can only be described as spectacular. And many developing nations are now well along the way to industrialization.

This trend to industrialization has brought new opportunities to the citizens of developing countries and provided a means for these countries to develop and employ local resources in accordance with advanced technology. Additional employment opportunities are generated by the infusion of capital and knowledge and the latest marketing, manufacturing and management methods.

Overseas investments also serve to stimulate the development of local manufacturing industries which supply large quantities of specialized services, materials, parts and components to motor vehicle producers. In addition, the expansion of dealer organizations for the marketing and servicing of motor vehicles provides a further contribution to the economic development of a country.

This approach to managing GM's operations in each country recognizes that the success of any business enterprise is dependent upon the economic health of its customers and on the goodwill and cooperation of the government and the people of the country in which it operates. By identifying with the country, GM continually strives to achieve these requirements for success.

New Records Set in 1972

In 1972, industry sales of cars and trucks overseas totaled approximately 18 million units, compared with 8 million ten years ago. Sales overseas have exceeded those in the U.S. and Canada in each year since 1967, and the gap is growing. Both areas will continue to grow, but overseas growth is expected to be more

rapid. By 1980, sales are projected to be 24 million overseas and 17 million in the U.S. and Canada.

General Motors established unit and dollar sales records outside the United States and Canada in 1972. Factory sales of 1,591,000 passenger cars and commercial vehicles produced overseas, together with sales of 81,000 exports from the United States and Canada, totaled 1,672,000 units, 5% above the previous record of 1,592,000 units set in 1971. In 1972, total sales attributable to operations outside the United States and Canada, including sales to United States and Canadian operations, amounted to $4.7 billion, a 15% increase over the record $4.1 billion established in the preceding year, and accounted for 14% of the Corporation's volume.

Net income attributable to operations outside the United States and Canada was $169 million in 1972, compared with $103 million in 1971. This was 8% of General Motors net income in 1972, compared with 5% in the previous year.

In Germany, factory sales of Adam Opel AG were a record 904,000 vehicles, compared with the previous record of 824,000 vehicles set in 1971. A primary reason for this performance was the success of Opel's new Rekord and Commodore models, which have helped Opel overtake its main competitor in Germany. In 1972, 427,000 units, or 47% of total Opel production, were exported for sale outside of Germany.

Factory sales of English-built Vauxhall cars and Bedford trucks totaled 273,000 units in 1972, 18% below factory sales of 331,000 units in 1971, when a major competitor experienced a long strike. The decline was principally in Vauxhall's export sales, which still represented 25% of Vauxhall's total units.

General Motors-Holden's Pty. Limited in Australia had total factory sales of 189,000 vehicles during the year, compared with factory sales of 188,000 vehicles in 1971. An increase in Holden export sales for the third consecutive year and strong domestic commercial vehicle sales more than offset a decline in domestic passenger car sales.

Factory sales by General Motors do Brasil S. A. in 1972 amounted to 102,000 units, a new record. This compared with the previous high of 82,000 units set in 1971. Brazil is experiencing rapid economic growth, and the Brazilian government's commitment to economic development through private industry has led to Brazil's emergence as a major vehicle-producing country.

Elsewhere in Latin America, factory sales of GM Argentina S. A. amounted to 28,000 vehicles, compared with 31,000 units in 1971. In Mexico, factory sales of General Motors de Mexico S. A. de C. V. totaled 32,000 vehicles, compared with 30,000 in 1971.

Factory sales by General Motors South African (Pty.) Limited amounted to 23,000 units in 1972, compared with 17,000 units in the previous year.

New Investments

Overseas sales of GM-produced cars and trucks accounted for almost 9% of industry vehicle sales outside the United States and Canada. GM is seeking to meet the demand for its products by participating in the more mature markets which are important today, as well as in the emerging areas of the world.

In 1971, General Motors acquired a 34.2% interest in Isuzu Motors Limited, a Japanese manufacturer of passenger cars and trucks. Through its investment in Isuzu, GM will participate in the rapidly expanding Japanese demand for vehicles, particularly the growing demand for trucks. In addition, Isuzu will provide GM with a Japanese source of vehicles to be marketed through GM's worldwide organization.

In 1972, GM joined with three Japanese companies to form a new company, GM Allison Japan Limited, which is owned 50% by GM, 20% by Isuzu Motors Limited, 20% by Kawasaki Heavy Industries Ltd. and 10% by C. Itoh & Co., Ltd. The new company will soon begin importing heavy-duty Allison automatic transmissions from the U.S. for installation in Japanese-made trucks. When GM industrial gas turbines become commercially available, GM Allison Japan will also import them for installation in Japanese-made equipment. If a sufficient demand develops in Japan for either or both of these products, GM Allison Japan will move into local assembly and eventual manufacture.

In the Republic of Korea, GM and the Shinjin Group of companies became equal shareholders in and formed a new company, General Motors Korea Company, Ltd. during 1972. GM Korea is assembling a Holden-source passenger car and is adding an Opel passenger car and a line of trucks and buses to its product offerings. The local content of these vehicles will be progressively increased, and, within a few years, the products will be manufactured almost entirely in Korea.

In 1972, GM and two Philippine vehicle assemblers, Yutivo Corporation and Francisco Motors Corporation, formed General Motors Philippines, Inc., to assemble cars and commercial vehicles. GM is a 60%

owner in this company. GM also established a wholly-owned subsidiary, GM Philippines Manufacturing Corporation, which will manufacture transmissions for export, as well as for vehicles assembled locally.

In Thailand, GM has acquired a 49% interest in Bangchan General Assembly Company Ltd., which is assembling vehicles for distribution by a wholly-owned GM subsidiary, General Motors Thailand Ltd.

In Africa, a new, wholly-owned subsidiary, GM Zaire S.A.R.L., is establishing facilities in Kinshasa, Zaire, for the assembly of GM vehicles.

In other overseas areas, GM is continuing with studies, discussions and negotiations which could result in additional new operations. The long-range potential for automobile sales in the emerging areas of the world is promising. As part of its program to participate in these opportunities, GM hopes to establish within its organization interchange programs for vehicle components on a regional basis in order to achieve an economic volume of production. At the same time, this will contribute to the industrial growth of the United States and other participating countries.

Employment Overseas

General Motors has always followed a long-standing practice of continually seeking to hire, train and promote nationals in the overseas countries in which it operates. GM's practice has been to provide an environment in which employes are able to develop their skills and capabilities, thus improving the pool of managerial talent from which it is able to draw. The Corporation's employment statistics confirm this—of GM's total overseas employment of approximately 183,000 at the end of 1972, only some 350 are assigned from the U.S. to overseas locations.

Employes from the U.S. are assigned to overseas positions for two reasons. First, in some countries there are shortages of qualified local personnel with a broad background of GM experience and an understanding of the interdependence of GM's worldwide operations. Second, certain operating positions require managerial or technical skills not always available locally. While a growing number of key managerial and technical personnel are being recruited and trained locally, the availability of qualified local personnel in some countries grows even more critical as many multinational companies expand throughout the world.

General Motors has for many years financed its overseas operations primarily by retained earnings and by local borrowing, with the borrowings repaid through funds generated within such operations. This long-established policy has resulted in a significant contribution to the U.S. balance of payments. In 1972, GM operations outside the United States made a favorable contribution of $396 million to the U.S. balance of payments. General Motors favorable contribution since the end of World War II has been $14.1 billion.

GM's growth overseas has not been at the expense of expanded investment and employment in the United States. Between 1962 and 1972, General Motors domestic employment rose 19%, compared with only 12% for U.S. manufacturing as a whole. Although GM overseas employment during the same period rose at a higher rate, this was because automobile production overseas was at a much lower level of development in 1962.

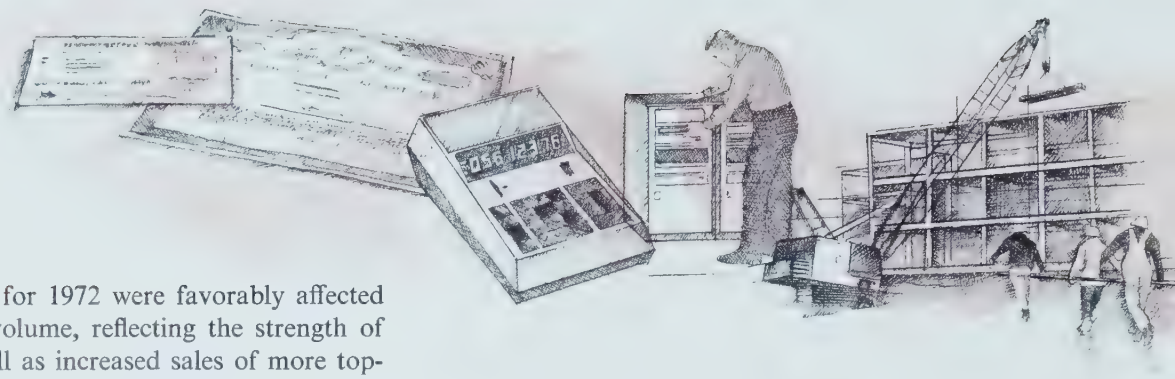
A Look Ahead

The trend toward multinational investment has been accelerated by the creation of the European Common Market and the increasing industrialization of the developing nations. Because of its investment in many of these countries, GM is participating in areas of the world from which it might otherwise be excluded.

Today, a chief characteristic of the multinational company's worldwide potential is diversity—a variety of national economies at different stages of development, each with distinct requirements for serving the public. Another is the rapid pace of change in many of these national economies, and a third factor is the variety of goals set by various nations. Each national economy has unique policies and attitudes and, because of this, presents its own combination of challenges and opportunities.

Against this background, General Motors has established and expanded the worldwide manufacturing, assembly and warehousing facilities necessary to participate in these expanding new opportunities. Now, GM products are sold and serviced in most countries of the world. In a number of countries abroad, GM also manufactures automotive components and accessories, Frigidaire household and commercial appliances and TEREX off-highway earthmoving equipment.

General Motors is working hard to meet the challenge of providing economical, personal transportation for millions in the more advanced countries and to be instrumental in the development of a sound automotive industry to serve the needs and aspirations of the developing nations.



Operating results for 1972 were favorably affected by increased sales volume, reflecting the strength of the economy, as well as increased sales of more top-of-the-line models and optional equipment. Also, improved operating efficiencies as a result of continued cost-reduction efforts and a sustained high level of capacity utilization contributed significantly to the improvement, despite the adverse effects of local strikes which caused a production loss of about 200,000 units.

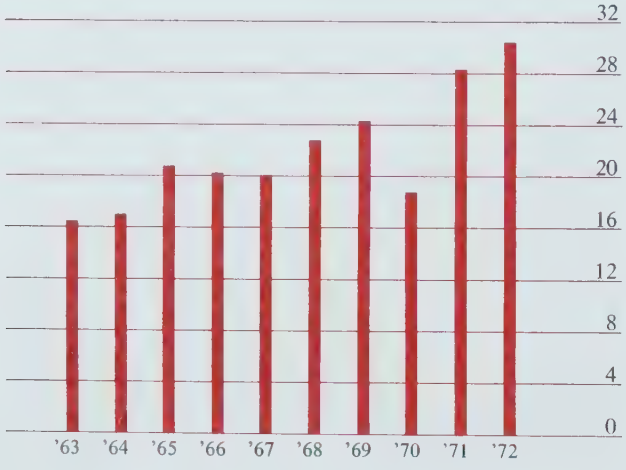
Net income in 1972 was $2,163 million, compared with $1,936 million in 1971 and the previous record of $2,126 million set in 1965. Earnings per share of common stock in 1972 were $7.51, compared with $6.72 per share in 1971 and $7.41 per share in the previous record year 1965. Comparing 1972 with 1965 indicates that earnings have not kept pace with other factors in GM's business. While earnings in 1972 were 2% higher than 1965, unit sales were up 7%, dollar sales up 47%, payrolls up 59% and stockholders' equity was up 42%. Over the period, profit as a percent to sales dropped from 10.3% in 1965 to 7.1% in 1972, slightly higher than the 6.8% in 1971.

The lower profit margin compared with 1965 in a year of record sales is largely a consequence of rising costs and improvements in our products, not matched by price increases. The 1972 operations also reflected the adverse effect of a series of local strikes. Strikes by the United Automobile Workers briefly shut down ten plants in the latter part of the year. Earlier, the GMAD assembly plant in Lordstown, Ohio, was shut down for three weeks, and the Norwood, Ohio, plant was closed for 174 days.

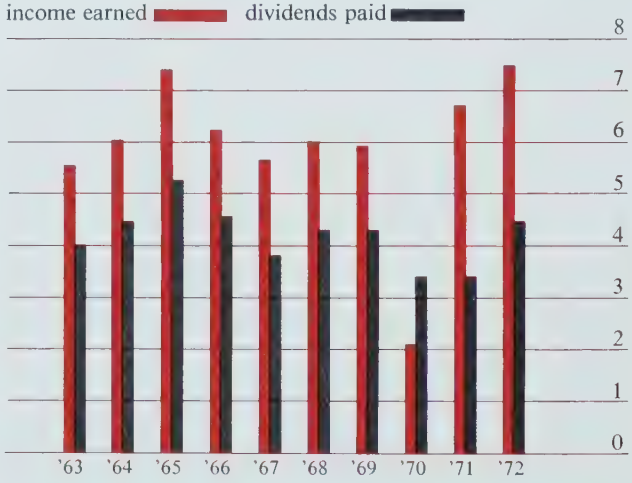
Throughout the world, dollar sales of GM products totaled a record $30.4 billion, compared with $28.3 billion in 1971, the previous record year. Before elimination of intercompany sales among United States, Canadian and Overseas operations, United States operations accounted for 78% of worldwide dollar sales in 1972, with Canadian and Overseas operations contributing 8% and 14%, respectively.

Estimated net income attributable to United States operations was 88% of total net income for 1972. Net income attributable to Canadian and Overseas operations was 4% and 8%, respectively, of the 1972 total.

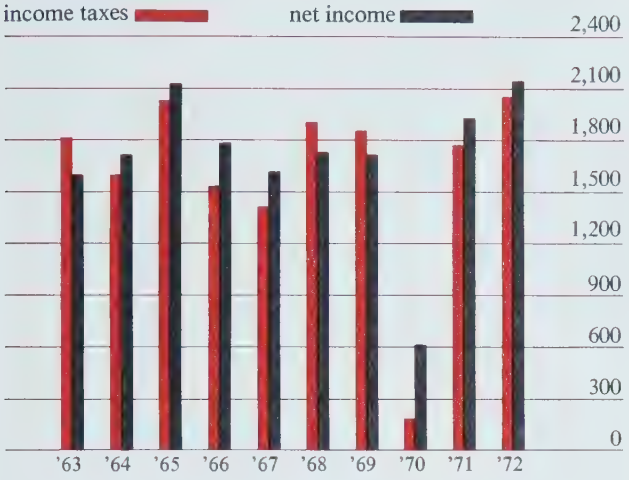
Dollar Sales
billions of dollars



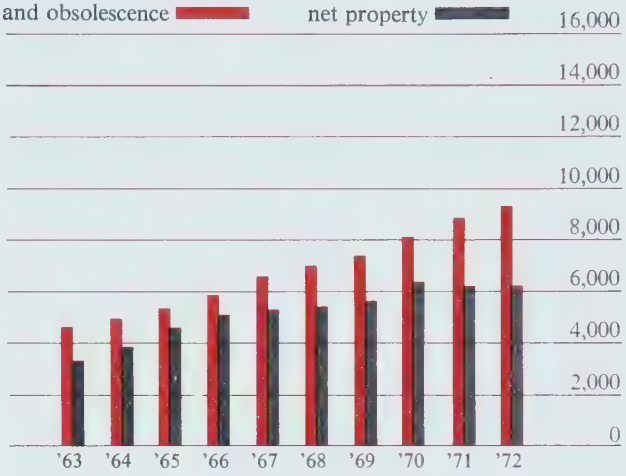
Earned Per Share of Common Stock
dollars



Income Taxes and Net Income
millions of dollars



Property
millions of dollars



These percentage contributions to sales and net income are comparable to those in recent years, except for 1970, when United States and Canadian operations were adversely affected by the UAW strike. Of the total of such income attributed to U.S. operations in 1972, approximately 97% was accounted for by automotive products. Nonautomotive and defense and space products accounted for the remainder of income attributable to U.S. operations.

Dividends paid on the common stock totaled $4.45 per share in 1972 and $3.40 per share in 1971, compared with $5.25 in 1965. The dividend paid in 1972 was within the dividend guidelines issued by the Government's Committee on Interest and Dividends.

Prices

Early in July of 1972, General Motors filed a price increase request with the Price Commission for an average increase of $85 on a cost pass-through basis, in partial recognition of costs for safety and emission changes, increased costs due to the Federal Occupational Safety and Health Act (OSHA) and GM-initiated design improvements. In August, GM reconsidered its request and reduced the proposed increase to an average $54, covering only government-mandated changes in emissions, bumpers and other safety equipment.

This request was suspended by the Price Commission in late August, pending availability of GM profit data for the third quarter. Subsequently, public hearings were held on the proposed pricing and cost data on 1973 models, which had previously been filed with the Price Commission by the automotive companies.

General Motors' 1973 model cars and trucks were introduced in September at 1972 model prices except for selected adjustments granted by the Price Commission for optional equipment made standard. These changes resulted in an average $5 retail list price adjustment for equipped vehicles.

On November 2, 1972, GM resubmitted its request for an average $54 adjustment, following submission to the Price Commission of GM's third quarter earnings and profit margin data as required by the regulations. Approval was received from the Commission on December 1, 1972, for the average $54 per equipped vehicle, equivalent to 1.2% of retail list price, and implementation was made effective December 4.

On December 8, 1972, General Motors asked the Price Commission for authority to increase prices by an average 3% for 1973 cars, trucks and options and by an average 3.5% for nonautomotive and miscellaneous business. These requests, which were for recovery of allowable cost increases incurred since December 31, 1971, reduced by a government-specified productivity factor, were subsequently suspended by the Price Commission and were pending when Phase III of the President's Economic Stabilization Program was announced on January 11, 1973. At that time, General Motors stated that in view of these modifications in the program, it would defer any decision on future prices until there has been sufficient time to evaluate the effect of Phase III on its business. Prices for GM products have remained unchanged since Phase III was announced.

Taxes

The provision for United States, foreign and state and local income taxes in 1972 was $2,060 million, compared with $1,784 million in 1971. Together with other state and local taxes and General Motors' share of social security taxes, the total tax provision in 1972 was $2,978 million, compared with $2,560 million in 1971. In 1972, this total tax provision was equivalent to $1.38 for every dollar of net income and $10.41 per share of common stock, which compares to $1.32 for every dollar of net income and $8.95 per share in 1971.

Expenditures for Plant, Equipment and Special Tools

Expenditures for plant and equipment throughout the world totaled $940 million in 1972, and provided for capacity expansion, modernization and plant replacements. Of these expenditures, approximately 80% was made in the United States, 3% in Canada and 17% overseas. In 1971, spending for plant and equipment totaled $1,013 million. Depreciation and obsolescence charged to income in 1972 was $912 million, compared with $873 million in 1971.

Expenditures for special tools were $898 million in 1972 and $631 million in 1971. Tool amortization amounted to $874 million in 1972 and $918 million in 1971.

Working Capital

Working capital at December 31, 1972, totaled $5,565 million, an increase of $1,035 million over the $4,530 million working capital at December 31, 1971. The increase in 1972 is due primarily to the excess of net income over dividends paid to stockholders. Borrowings by foreign subsidiaries resulted in a net increase of $175 million in long-term debt to provide funds for expansion programs, principally in Europe and Latin America. Expenditures for plant facilities and special tools exceeded depreciation and amortization by $52 million. A statement setting forth the changes in financial position and the changes in working capital by element appears on page 32.

Common Stockholders' Equity

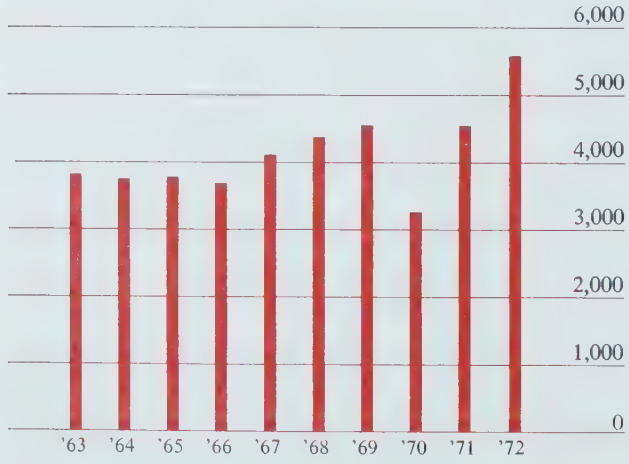
The equity of the holders of General Motors common stock is represented by the common stock, capital surplus and net income retained for use in the business. This amounted to $11,399 million at the end of 1972, compared with $10,522 million at the end of 1971. Book value per share of General Motors common stock increased from $36.58 at the end of 1971 to $39.64 at the end of 1972.

Pension Funds

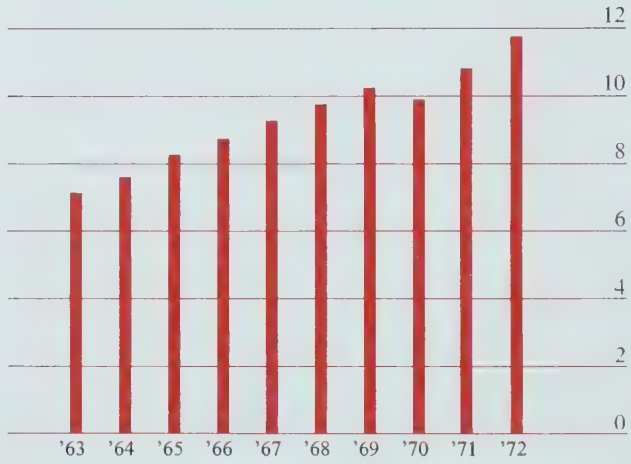
Under the pension plan for hourly employes and the trusteed part of the retirement program for salaried employes, pension funds in the United States are managed by a group of independent bank trustees. Stated at cost, these funds totaled $3.6 billion at the end of 1972. General Motors payments into the trusts and net income earned by the trusts totaled $717 million during 1972. Reflecting pension payments amounting to $312 million, the resulting net increase in the pension funds for the year amounted to $405 million. Details are shown in the tabulation on page 38.

Three insurance companies administer the insured part of the U. S. salaried employes' retirement program. Separate arrangements are made for employes in Canada and other countries where General Motors pension plans are in effect.

Working Capital
millions of dollars



Stockholders' Equity Common and Preferred Stockholders
billions of dollars



GENERAL MOTORS CORPORATION and Consolidated Subsidiaries

STATEMENT OF CONSOLIDATED INCOME

for the years ended December 31, 1972 and 1971

	Year 1972	Year 1971
NET SALES	**$30,435,231,414**	$28,263,918,443
Equity in earnings of nonconsolidated subsidiaries and associates (dividends received amounted to $53,894,756 in 1972 and $49,188,014 in 1971)	**103,733,982**	100,641,084
Other income less sundry income deductions (net deduction) (Note 2)	**71,045,353**	(36,441,991)
TOTAL	**30,610,010,749**	28,328,117,536
COSTS AND EXPENSES		
Cost of sales and other operating charges, exclusive of items listed below	**23,336,854,644**	21,620,860,324
Selling, general and administrative expenses	**1,162,537,263**	1,106,778,977
Depreciation and obsolescence of real estate, plants and equipment	**912,432,511**	873,102,334
Amortization of special tools	**874,221,875**	917,566,408
Provision for Bonus Plan and Stock Option Plan (Note 10)	**101,357,691**	90,000,000
United States, foreign and other income taxes (Note 3)	**2,059,800,000**	1,784,100,000
TOTAL	**28,447,203,984**	26,392,408,043
NET INCOME for the year	**2,162,806,765**	1,935,709,493
Dividends on preferred stocks	**12,928,270**	12,928,272
EARNED ON COMMON STOCK	**$ 2,149,878,495**	$ 1,922,781,221
Average number of shares of common stock outstanding during the year	**286,099,648**	286,006,615
EARNED PER SHARE OF COMMON STOCK (Note 11)	**$7.51**	$6.72

Reference should be made to notes on pages 33 through 37.

GENERAL MOTORS CORPORATION

CONSOLIDATED

December 31,

ASSETS

	Dec. 31, 1972	Dec. 31, 1971
CURRENT ASSETS		
Cash	**$ 379,618,630**	$ 330,874,832
United States and other government securities and time deposits—at cost, which approximates market:		
Held for payment of income taxes	**603,715,489**	1,366,041,228
Other	**1,963,607,352**	1,645,211,378
Accounts and notes receivable (Note 4)	**2,806,202,114**	2,724,213,647
Inventories	**4,200,163,355**	3,991,569,173
Prepaid expenses	**585,214,833**	478,797,038
TOTAL CURRENT ASSETS	**10,538,521,773**	10,536,707,296
INVESTMENTS AND MISCELLANEOUS ASSETS		
Equity in net assets of nonconsolidated subsidiaries and associates (Note 5)	**1,141,536,540**	1,081,910,684
Other investments and miscellaneous assets—at cost (less allowances)	**93,256,312**	127,138,450
TOTAL INVESTMENTS AND MISCELLANEOUS ASSETS	**1,234,792,852**	1,209,049,134
COMMON STOCK HELD FOR INCENTIVE PROGRAM (Note 6)	**129,540,350**	130,668,064
PROPERTY		
Real estate, plants and equipment (Note 7)	**14,748,057,536**	14,242,155,542
Less accumulated depreciation and obsolescence (Note 7)	**9,270,232,890**	8,734,764,033
Net real estate, plants and equipment	**5,477,824,646**	5,507,391,509
Special tools—less amortization	**720,699,933**	696,379,317
TOTAL PROPERTY	**6,198,524,579**	6,203,770,826
DEFERRED CHARGES		
Goodwill—less amortization	**44,409,726**	50,753,972
Deferred income taxes and other	**127,592,755**	56,357,122
TOTAL DEFERRED CHARGES	**172,002,481**	107,111,094
TOTAL ASSETS	**$18,273,382,035**	$18,187,306,414

Reference should be made to notes on pages 33 through 37.
Certain amounts for 1971 have been reclassified to reflect comparability with classifications for 1972.

and Consolidated Subsidiaries

BALANCE SHEET

1972 and 1971

LIABILITIES, RESERVES AND STOCKHOLDERS' EQUITY

	Dec. 31, 1972	Dec. 31, 1971
CURRENT LIABILITIES		
Accounts, drafts and loans payable	**$ 2,469,823,840**	$ 2,206,310,295
United States, foreign and other income taxes payable	**760,322,253**	1,735,829,334
Other taxes, payrolls and sundry accrued items	**1,743,600,748**	2,064,180,370
TOTAL CURRENT LIABILITIES	**4,973,746,841**	6,006,319,999
LONG-TERM DEBT (principally foreign subsidiaries) (Note 8)	**790,876,437**	615,617,040
OTHER LIABILITIES	**380,365,697**	339,900,008
DEFERRED CREDITS AND RESERVES		
Deferred investment tax credits	**169,838,391**	151,732,000
Contingent credits under Stock Option Plan	**21,100,000**	23,663,338
General reserve applicable to foreign operations	**141,667,396**	141,667,396
Other (principally deferred intercompany profits)	**112,908,250**	103,169,341
TOTAL DEFERRED CREDITS AND RESERVES	**445,514,037**	420,232,075
STOCKHOLDERS' EQUITY (Notes 9 and 10)		
Capital stock:		
Preferred:		
$5.00 series	**183,564,400**	183,564,400
$3.75 series	**100,000,000**	100,000,000
Common	**479,360,875**	479,340,467
Total capital stock	**762,925,275**	762,904,867
Capital surplus (principally additional paid-in capital)	**766,945,776**	766,136,647
Net income retained for use in the business	**10,153,007,972**	9,276,195,778
TOTAL STOCKHOLDERS' EQUITY	**11,682,879,023**	10,805,237,292
TOTAL LIABILITIES, RESERVES AND STOCKHOLDERS' EQUITY	**$18,273,382,035**	$18,187,306,414

GENERAL MOTORS CORPORATION and Consolidated Subsidiaries

STATEMENT OF CHANGES IN CONSOLIDATED FINANCIAL POSITION

for the years ended December 31, 1972 and 1971

	Year 1972	Year 1971
Source of Funds		
Net income	**$2,162,806,765**	$1,935,709,493
Depreciation and obsolescence of real estate, plants and equipment	**912,432,511**	873,102,334
Amortization of special tools	**874,221,875**	917,566,408
Undistributed earnings of nonconsolidated subsidiaries and associates, deferred income taxes, etc.—net	**(98,357,457)**	(164,609,583)
Total current operations	**3,851,103,694**	3,561,768,652
Disposals and retirements of property	**57,171,936**	57,382,512
Increase in long-term debt	**175,259,397**	334,394,340
Proceeds from sale of newly issued common stock	**706,164**	922,090
Total	**4,084,241,191**	3,954,467,594
Application of Funds		
Dividends paid to stockholders	**1,285,994,571**	985,371,948
Expenditures for real estate, plants and equipment	**940,037,584**	1,012,968,050
Expenditures for special tools	**898,542,491**	630,702,160
Investments in nonconsolidated subsidiaries and associates	**9,786,630**	47,514,676
Other—net	**(84,507,720)**	15,114,436
Total	**3,049,853,556**	2,691,671,270
Increase in working capital during the year	**1,034,387,635**	1,262,796,324
Working capital at beginning of the year	**4,530,387,297**	3,267,590,973
Working capital at end of the year	**$5,564,774,932**	$4,530,387,297
Increase (Decrease) in Working Capital by Element		
Cash, government securities and time deposits	**($ 395,185,967)**	$2,911,682,479
Accounts and notes receivable	**81,988,467**	998,547,666
Inventories	**208,594,182**	(123,491,324)
Prepaid expenses	**106,417,795**	221,673,259
Accounts, drafts and loans payable	**(263,513,545)**	(546,417,302)
United States, foreign and other income taxes payable	**975,507,081**	(1,522,071,177)
Other taxes, payrolls and sundry accrued items	**320,579,622**	(677,127,277)
Increase in working capital during the year	**$1,034,387,635**	$1,262,796,324

Reference should be made to notes on pages 33 through 37.

Certain amounts for 1971 have been reclassified to reflect comparability with classifications for 1972.

NOTES TO FINANCIAL STATEMENTS

Note 1. SIGNIFICANT ACCOUNTING POLICIES

PRINCIPLES OF CONSOLIDATION

The consolidated financial statements include the accounts of the Corporation and all domestic and foreign subsidiaries which are engaged principally in manufacturing or wholesale marketing of General Motors products. General Motors' share of earnings or losses of nonconsolidated subsidiaries and of associates in which at least 20% of the voting securities is owned is generally included in consolidated income under the equity method of accounting. Intercompany items and transactions between companies included in the consolidation are eliminated and unrealized intercompany profits on sales to nonconsolidated subsidiaries and to associates, the investments in which are accounted for by the equity method, are deferred.

TRANSLATION OF FOREIGN CURRENCIES

Real estate, plants and equipment, accumulated depreciation and obsolescence and the provision for depreciation and obsolescence are translated into United States dollars at exchange rates in effect at the dates the related assets were acquired. Other assets and liabilities, deferred credits and reserves are translated at exchange rates in effect at the date of the balance sheet; other items of income and expense are translated at average exchange rates for the months in which the transactions occurred. Accumulated unrealized net loss from translation of foreign currency accounts of any foreign subsidiary is charged to income and accumulated unrealized net gain is deferred.

INCOME TAXES

Investment tax credits allowable under the income tax laws are deducted in determining taxes estimated to be payable currently and are deferred and amortized over the lives of the related assets. The tax effects of timing differences between pretax accounting income and taxable income are deferred, except that the tax effects of certain expenses charged to income prior to 1968 have not been deferred but are recognized in income taxes provided at the time such expenses become allowable deductions for tax purposes. Provisions are made for estimated United States and foreign taxes, less available tax credits and deductions, which may be incurred on remittance of the Corporation's share of subsidiaries' and associates' undistributed earnings included in the consolidated financial statements.

INVENTORIES

Inventories are stated at the lower of cost or market. Cost is determined substantially by the first-in, first-out or the average cost method. Market value is current sales price less distribution cost for finished product and replacement cost for other inventories. Physical inventories are taken at all locations.

COMMON STOCK HELD FOR INCENTIVE PROGRAM

Common stock in treasury is held exclusively for payment of liabilities under the Incentive Program and is stated substantially at cost.

PROPERTY, DEPRECIATION AND AMORTIZATION

Property is stated at cost. Maintenance, repairs, rearrangement expenses and renewals and betterments which do not enhance the value or increase the basic productive capacity of the assets are charged to costs and expenses as incurred.

The annual group (composite) rates of depreciation are, with minor exceptions, as follows:

Classification of Property	Annual Group Rates
Land improvements	5%
Buildings	3½%
Machinery and equipment	8⅓% (Average)
Furniture and office equipment	6% (Average)

Depreciation is not provided in excess of 100% of the gross book amount of a given group as a whole. Depreciation on groups which are not 100% depreciated is, with minor exceptions, accrued at 150% and 100% of the applicable rate shown above for the first and second thirds, respectively, of estimated useful life and thereafter at 50% of such rate for the balance of time the asset remains in service. Use of this accelerated method accumulates depreciation of approximately two-thirds of the depreciable cost during the first half of the estimated lives of the property.

Expenditures for special tools are amortized, with the amortization applied directly to the asset account, over short periods of time because the utility value of the tools is radically affected by frequent changes in the design of the functional components and appearance of the product. Replacement of special tools for reasons other than changes in products is charged directly to cost of sales.

GOODWILL

Goodwill relates to businesses acquired in 1943 and prior years and, beginning in 1970, is being amortized over a period of ten years at the rate of $6,344,246 per year, with the amortization applied directly to the asset account.

INCENTIVE PROGRAM

A reserve is maintained for purposes of the Bonus Plan and Stock Option Plan to which may be credited each year an amount which the independent public accountants of the Corporation determine in accordance with the provisions of the Bonus Plan; however, for any year the Bonus and Salary Committee may direct that a lesser amount be credited. Bonus awards under the Bonus Plan, contingent credits under the Stock Option Plan and such other amounts arising out of the operation of the Incentive Program as the Committee may determine are charged to the reserve. As a result of tentative determinations of awards by the Committee, the amount provided is transferred to current liabilities, other liabilities and deferred credits at December 31.

The Bonus and Salary Committee may determine that participants have not met the requirements entitling them to receive undelivered instalments of bonus awards and contingent credits; the amount of any such instalments is credited to income. Upon the exercise of stock options, the related contingent credits are proportionately reduced with the amount of the reduction credited to income.

Note 1. SIGNIFICANT ACCOUNTING POLICIES (concluded)

GENERAL RESERVE APPLICABLE TO FOREIGN OPERATIONS

The general reserve applicable to foreign operations was established in 1954 and is available to absorb extraordinary losses, such as losses from discontinuing foreign operations in any locality, either voluntarily or because of conditions beyond the Corporation's control. There has been no change in this reserve since its establishment.

PENSION PROGRAM

The Corporation and its subsidiaries have several pension plans covering substantially all employes. Generally, plans covering hourly-rate employes are noncontributory and those covering salaried employes are both contributory and noncontributory. Benefits under the plans are generally related to an employe's length of service, wages and salaries and contributions. The costs of these plans are determined on the basis of actuarial cost methods and include amortization of prior service cost over periods not exceeding 30 years. With the exception of certain overseas subsidiaries, pension costs accrued are funded.

The total pension expense of the Corporation and its consolidated subsidiaries amounted to $640 million in 1972 and $584 million in 1971. The actuarially computed value of vested benefits of all plans was less than the total of pension funds, at market, and balance-sheet accruals as of December 31, 1972.

Note 2. OTHER INCOME LESS SUNDRY INCOME DEDUCTIONS

	1972	1971
Other income:		
Interest income	$ 135,375,959	$ 81,223,911
Other	20,538,877	19,758,627
Sundry income deductions:		
Interest and related charges on long-term debt	(46,771,305)	(26,355,559)
Other interest	(28,191,405)	(29,304,364)
Gain (Loss) on translation of financial statements in foreign currencies—net	482,470	(27,783,629)
Other	(10,389,243)	(53,980,977)
Net	$ 71,045,353	($ 36,441,991)

Note 3. UNITED STATES, FOREIGN AND OTHER INCOME TAXES

	1972	1971
Taxes estimated to be payable currently:		
United States Federal	$1,595,391,659	$1,548,254,273
Foreign	279,599,443	173,520,398
United States state and local	254,400,000	211,600,000
Total	2,129,391,102	1,933,374,671
Investment tax credits:		
Deferred	51,080,601	29,621,000
Amortized	(32,974,210)	(31,647,000)
Deferred income taxes—net	(87,697,493)	(147,248,671)
Total	$2,059,800,000	$1,784,100,000

Note 4. ACCOUNTS AND NOTES RECEIVABLE

	1972	1971
General Motors Acceptance Corporation (relating to current wholesale financing of sales of General Motors products)	$1,491,529,301	$1,102,348,920
Other trade and sundry receivables (less allowances)	1,314,672,813	1,621,864,727
Total	$2,806,202,114	$2,724,213,647

Note 5. EQUITY IN NET ASSETS OF NONCONSOLIDATED SUBSIDIARIES AND ASSOCIATES

	1972	1971
Nonconsolidated subsidiaries:		
General Motors Acceptance Corporation and its subsidiaries (finance and insurance companies) (See page 39)	$ 948,002,595	$ 899,611,570
Dealerships operating under dealership assistance plans (retail companies)	110,378,744	119,737,191
Other domestic and foreign subsidiaries	6,159,174	5,850,514
Associates (interests in overseas companies)	76,996,027	56,711,409
Total	$1,141,536,540	$1,081,910,684

Note 6. COMMON STOCK HELD FOR INCENTIVE PROGRAM

	1972		1971	
	Shares	Amount	Shares	Amount
Balance at beginning of the year	1,704,658	$130,668,064	2,014,409	$155,739,226
Acquired for employe plans	635,702	49,974,989	513,253	41,489,128
Sold to trustees of the Savings-Stock Purchase Program (a)	—	—	(337,202)	(27,342,318)
Delivered to Incentive Program participants	(646,735)	(51,226,076)	(485,802)	(39,425,007)
Revaluation in accordance with the Bonus Plan	—	123,373	—	207,035
Balance at end of the year:				
Held for instalment deliveries of bonus awards and contingent credits related to prior years	765,842	57,368,659	722,266	58,199,084
Available for contingent credits related to outstanding stock options	222,601	17,168,904	303,159	23,663,338
Available for current bonus awards and contingent credits	705,182	55,002,787	679,233	48,805,642
Total	1,693,625	$129,540,350	1,704,658	$130,668,064

(a) During 1971 the trustees of the Savings-Stock Purchase Program began obtaining plan requirements in the open market.

Note 7. REAL ESTATE, PLANTS AND EQUIPMENT

	1972	1971
Real estate, plants and equipment—at cost:		
Land	$ 214,972,179	$ 202,036,324
Land improvements	490,121,004	470,117,955
Leasehold improvements—less amortization	23,508,032	50,301,816
Buildings	3,773,047,598	3,623,910,067
Machinery and equipment	9,729,677,842	9,283,834,197
Furniture and office equipment	232,389,352	228,655,689
Construction in progress	284,341,529	383,299,494
Total	$14,748,057,536	$14,242,155,542
Accumulated depreciation and obsolescence:		
Land improvements	$ 285,323,752	$ 263,838,304
Buildings	2,057,908,137	1,939,879,728
Machinery and equipment	6,718,011,419	6,330,065,373
Furniture and office equipment	159,659,452	151,650,498
Extraordinary obsolescence	49,330,130	49,330,130
Total	$ 9,270,232,890	$ 8,734,764,033

Note 8. LONG-TERM DEBT (Less Current Portion)

	Due	1972	1971
General Motors Corporation—United States dollars	1974-2000	$116,383,137	$ 34,079,000
Subsidiaries:			
United States dollars	1974-86	260,000,000	191,389,140
Canadian dollars	1976	100,440,000	99,750,000
German marks	1974-79	177,287,000	155,538,300
Swiss francs	1976	53,000,000	51,040,000
British pounds	1975-92	64,625,000	51,000,000
French francs	1974-78	10,302,000	12,581,700
Belgian francs	1974-77	1,138,000	15,524,800
Other currencies	1974-84	7,701,300	4,714,100
Total		$790,876,437	$615,617,040

Maturities of long-term debt at December 31, 1972 for each of the five years through 1977 are: 1973—$23,367,103 (included in current liabilities); 1974—$56,795,721; 1975—$67,929,204; 1976—$274,058,830 and 1977—$115,243,386.

NOTES TO FINANCIAL STATEMENTS (continued)

Note 9. STOCKHOLDERS' EQUITY

	1972	1971
Preferred Stock, without par value (authorized, 6,000,000 shares):		
$5.00 series, stated value $100 per share, redeemable at $120 per share (issued, 1,875,366 shares; in treasury, 39,722 shares; outstanding, 1,835,644 shares)	**$ 183,564,400**	**$ 183,564,400**
$3.75 series, stated value $100 per share, redeemable at $100 per share (issued and outstanding, 1,000,000 shares)	**100,000,000**	**100,000,000**
Common Stock, $1⅔ par value (authorized, 500,000,000 shares):		
Issued at beginning of the year (287,604,280 shares in 1972 and 287,586,179 shares in 1971)	479,340,467	479,310,298
Newly issued under the Stock Option Plan (12,245 shares in 1972 and 18,101 shares in 1971)	20,408	30,169
Issued at end of the year (287,616,525 shares in 1972 and 287,604,280 shares in 1971)	**479,360,875**	**479,340,467**
Capital Surplus (principally additional paid-in capital):		
Balance at beginning of the year	766,136,647	765,037,691
Paid-in capital in excess of par value of newly issued common stock sold under provisions of the Stock Option Plan	685,756	891,921
Increase in carrying value of common stock held for the Incentive Program revalued in accordance with the Bonus Plan	123,373	207,035
Balance at end of the year	**766,945,776**	**766,136,647**
Net Income Retained for Use in the Business:		
Balance at beginning of the year	9,276,195,778	8,325,858,233
Net income	2,162,806,765	1,935,709,493
Total	11,439,002,543	10,261,567,726
Cash dividends:		
Preferred stock, $5.00 series, $5.00 per share	9,178,220	9,178,220
Preferred stock, $3.75 series, $3.75 per share	3,750,050	3,750,052
Common stock, $4.45 per share in 1972 and $3.40 per share in 1971	1,273,066,301	972,443,676
Total cash dividends	1,285,994,571	985,371,948
Balance at end of the year	**10,153,007,972**	**9,276,195,778**
Total Stockholders' Equity	**$11,682,879,023**	**$10,805,237,292**

Note 10. INCENTIVE PROGRAM

For the year 1972, the Bonus and Salary Committee directed a credit to the Reserve for Bonus Plan and Stock Option Plan of $101,357,691 (the maximum permitted under the Bonus Plan formula as set forth on page 38) and has tentatively determined that the total of individual awards shall approximate the amount credited to the reserve in 1972 subject, however, to the final determination of the Committee. As a result, $101,357,691 was transferred to current liabilities, other liabilities and deferred credits.

Changes during 1972 in the status of options granted under the Stock Option Plan are shown in the following table. The option prices are 100% of the average of the highest and lowest sales prices on the New York Stock Exchange on the dates the options were granted. No options were granted in 1972 or 1971. The Corporation intends to deliver newly issued stock upon the exercise of any of the outstanding options. The maximum number of shares for which additional options might be granted under the Plan was 2,309,573 at January 1, 1972 and 2,539,012 at December 31, 1972.

		Shares Under Option				
			Changes During Year			
Year Granted	Option Price	Jan. 1, 1972	Granted	Exercised	Terminated	Dec. 31, 1972
1962	$56.82	29,758	—	10,627	19,131	—
1963	63.25	78,543	—	1,618	6,194	70,731
1967	73.19	151,725	—	—	151,725	—
1968	74.50	185,169	—	—	16,143	169,026
1969	78.07	217,452	—	—	17,592	199,860
1970	69.82	246,846	—	—	18,654	228,192
	Total	909,493	—	12,245	229,439	667,809

Note 11. EARNINGS PER SHARE

Earnings per share of common stock are based on the average number of shares outstanding during each year. The effect on earnings per share resulting from the assumed exercise of outstanding options and delivery of bonus awards and contingent credits under the Incentive Program is not material.

Note 12. FOREIGN OPERATIONS

Net assets, sales and income attributable to operations outside the United States and Canada, included in the consolidated financial statements, are summarized in the following table. Net sales include sales to United States and Canadian operations. Net income includes provisions for deferred income taxes on unremitted earnings of such foreign operations and other consolidation adjustments and, in 1972, includes earnings (loss) attributable to the major overseas manufacturing subsidiaries, as follows: Adam Opel AG, $97 million; General Motors-Holden's Pty. Limited, $20 million; and Vauxhall Motors Limited, ($9 million).

Net Assets Attributable to Operations Outside the United States and Canada

	December 31, 1972				
	Western Europe	United Kingdom, Australia, New Zealand and South Africa	Other, Principally Mexico and South America	Total	December 31, 1971 Total
			(In Millions)		
Assets:					
Total current assets	$ 766	$ 648	$376	**$1,790**	$1,479
Property—net	526	360	195	**1,081**	1,075
Other assets	24	17	105	**146**	109
Total assets	1,316	1,025	676	**3,017**	2,663
Liabilities:					
Bank borrowings and notes payable	68	142	62	**272**	380
Other current liabilities	376	258	134	**768**	614
Total current liabilities	444	400	196	**1,040**	994
Long-term debt of subsidiaries	362	65	117	**544**	366
Other liabilities and reserves	143	70	18	**231**	206
Total liabilities	949	535	331	**1,815**	1,566
Balance	$ 367	$ 490	$345	**1,202**	1,097
Less General Reserve Applicable to Foreign Operations				**142**	142
Net Assets Attributable to Operations Outside the United States and Canada				**$1,060**	$ 955
Net Sales Attributable to Operations Outside the United States and Canada				**$4,741**	$4,112
Net Income Attributable to Operations Outside the United States and Canada				**$ 169**	$ 103

Note 13. CONTINGENT LIABILITIES

There are various claims and pending actions against the Corporation and its subsidiaries in respect of taxes, product liability, alleged patent infringements, warranties, alleged air pollution and other matters arising out of the conduct of the business. Certain of these actions purport to be class actions, seeking damages in very large amounts. The amounts of liability on these claims and actions at December 31, 1972 were not determinable but, in the opinion of the management, the ultimate liability resulting will not materially affect the consolidated financial position or results of operations of the Corporation and its consolidated subsidiaries.

ACCOUNTANTS' REPORT

HASKINS & SELLS
CERTIFIED PUBLIC ACCOUNTANTS

1114 AVENUE OF THE AMERICAS
NEW YORK 10036

FEBRUARY 14, 1973

GENERAL MOTORS CORPORATION, ITS DIRECTORS AND STOCKHOLDERS:

We have examined the Consolidated Balance Sheet of General Motors Corporation and consolidated subsidiaries as of December 31, 1972 and 1971 and the related Statements of Consolidated Income and Changes in Consolidated Financial Position for the years then ended. Our examination was made in accordance with generally accepted auditing standards, and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

In our opinion, these financial statements present fairly the financial position of the companies at December 31, 1972 and 1971 and the results of their operations and the changes in their financial position for the years then ended, in conformity with generally accepted accounting principles consistently applied.

Haskins & Sells

PENSION FUNDS HELD BY TRUSTEES IN THE UNITED STATES
Under the Hourly-Rate Pension Plan and the Trusteed Part of the Retirement Program for Salaried Employes

Funds at December 31, 1971—with securities valued at cost		$3,150,244,878
Additions during 1972:		
Payments by General Motors into trusts	$530,070,000	
Interest and dividends received	145,302,114	
Net profits realized on sales of securities	41,840,037	
Net additions before pension payments	$717,212,151	
Pension payments during 1972	312,027,831	405,184,320
Funds at December 31, 1972—with securities valued at cost		$3,555,429,198

NOTE: Payments by General Motors into trusts include an estimated $308 million attributable to prior service benefits provided under the original plan and by subsequent amendments. The cost of these prior service benefits is being amortized over 30 year periods from the dates the benefits were provided. The funds in these trusts include amounts applicable to non-consolidated subsidiaries and are held for payment of pension benefits and are not the property of the Corporation or any of its subsidiaries.

INCENTIVE PROGRAM

The Incentive Program consists of the General Motors Bonus Plan, first approved by stockholders in 1918, and the General Motors Stock Option Plan, adopted in 1957. The By-Laws provide that the Plans shall be presented for action at a stockholders' meeting at least once in every five years. In that connection both Plans were approved by the stockholders at the 1972 Annual Meeting.

The Corporation maintains a reserve for purposes of the Bonus Plan and the Stock Option Plan, to which may be credited each year an amount which the independent public accountants of the Corporation determine to be 8% of the net earnings which exceed 7% but not 15% of net capital, plus 5% of the net earnings which exceed 15% of net capital, but not in excess of the amount paid out as dividends on the common stock during the year. However, for any year the Bonus and Salary Committee may direct that a lesser amount be credited.

Bonus awards under the Bonus Plan, contingent credits under the Stock Option Plan, and such other amounts arising out of the operation of the Incentive Program as the Committee may determine are charged to the reserve.

Maximum Amount which may be Credited to the Reserve As Determined by the Independent Public Accountants:

Computation of net capital:		
Amounts at December 31, 1971 included in the Consolidated Balance Sheet, page 31:		
Total stockholders' equity		$10,805,237,292
Long-term debt of General Motors Corporation		34,079,000
Total		10,839,316,292
Add proportionate allowance for net increase during the year in capital stock, capital surplus and debt:		
Increase arising from sales of 12,245 shares of newly issued common stock under the provisions of the Stock Option Plan	$ 603,305	
Increase arising from net increase in long-term debt of General Motors Corporation in the principal amount of $83,872,140	42,070,975	42,674,280
Net capital (as defined in the Bonus Plan)		$10,881,990,572
Computation of net earnings for determination of credit:		
Net income reported in the Statement of Consolidated Income, page 29		$ 2,162,806,765
Add amounts charged to income:		
Provision for Bonus Plan and Stock Option Plan		101,357,691
Interest and discount on long-term debt of General Motors Corporation		2,690,758
Total		2,266,855,214
Deduct amounts credited to income:		
Portions of prior years' bonus awards which could not continue to be earned under the terms of the Bonus Plan	$ 96,872	
Reduction in contingent credits resulting from exercise of stock options under the Stock Option Plan during the year	200,734	297,606
Net earnings (as defined in the Bonus Plan)		2,266,557,608
Deduct 7% on net capital (equivalent to $2.62 per share of common stock)		761,739,340
Portion of net earnings upon which the maximum credit to the reserve is computed:		
Net earnings between 7% and 15% of net capital	$870,559,246	
Net earnings which exceed 15% of net capital	634,259,022	$ 1,504,818,268
Maximum amount which may be credited to the reserve:		
8% of the net earnings between 7% and 15% of net capital	$ 69,644,740	
5% of the net earnings which exceed 15% of net capital	31,712,951	$ 101,357,691

Amount Available for Bonus Awards and Contingent Credits:

Credit to the reserve as directed by the Bonus and Salary Committee	$ 101,357,691
Add unawarded balance in reserve carried forward from 1971	1,205,237
Total amount available in the reserve for awards under the Bonus Plan and for contingent credits under the Stock Option Plan	$ 102,562,928

Provisions for Bonus Plan and Stock Option Plan

There are shown below the provisions for the Bonus Plan and the Stock Option Plan before giving effect to the resulting reductions in income taxes.

1963.....$112,000,000	1965.....$130,000,000	1967.....$107,000,000	1969.....$110,000,000	1971.....$ 90,000,000
1964..... 116,000,000	1966..... 114,000,000	1968..... 111,000,000	1970..... —	1972..... 101,357,691

GENERAL MOTORS ACCEPTANCE CORPORATION

and Consolidated Subsidiaries

CONDENSED CONSOLIDATED BALANCE SHEET

December 31, 1972 and 1971

ASSETS

	December 31, 1972	December 31, 1971
CASH	$ 220,520,716	$ 176,365,465
MARKETABLE SECURITIES—short term—at cost	28,000,000	—
NOTES AND ACCOUNTS RECEIVABLE (including instalments maturing after one year: 1972—$4,212,023,193; 1971—$3,712,337,396; less unearned income: 1972—$678,406,977; 1971—$619,606,477 and reserves for losses: 1972—$121,693,670; 1971—$108,145,586)	11,766,336,782	10,761,135,663
INVESTMENT IN MOTORS INSURANCE CORPORATION (wholly-owned nonconsolidated subsidiary carried at equity in net assets as shown by its books)	72,100,531	56,082,801
UNAMORTIZED DEBT EXPENSE	18,936,491	15,949,574
OTHER ASSETS	39,146,278	38,995,107
TOTAL ASSETS	$12,145,040,798	$11,048,528,610

LIABILITIES, RESERVES AND STOCKHOLDER'S EQUITY

NOTES, LOANS AND DEBENTURES PAYABLE WITHIN ONE YEAR (less unamortized discount: 1972—$6,788,512; 1971—$12,048,236)	$ 4,858,544,532	$ 4,838,346,235
ACCOUNTS PAYABLE, ACCRUED LIABILITIES AND RESERVES		
General Motors Corporation and affiliated companies	1,494,597,236	1,104,956,367
Dealers	114,101,116	109,832,699
United States and foreign income and other taxes	43,694,578	34,506,265
Interest	83,171,889	68,451,789
Other	36,013,987	31,858,275
TOTAL ACCOUNTS PAYABLE, ACCRUED LIABILITIES AND RESERVES	1,771,578,806	1,349,605,395
NOTES, LOANS AND DEBENTURES PAYABLE AFTER ONE YEAR (maturing prior to 1998—less unamortized discount: 1972—$11,959,437; 1971—$9,418,880)	3,751,914,865	3,265,965,410
SUBORDINATED INDEBTEDNESS (maturing prior to 1993)	815,000,000	695,000,000
STOCKHOLDER'S EQUITY		
Preferred stock, $100 par value (authorized and outstanding, 1,100,000 shares):		
6% cumulative	75,000,000	75,000,000
7¼% cumulative	35,000,000	35,000,000
Common stock, $100 par value (authorized and outstanding, 3,650,000 shares)	365,000,000	365,000,000

Net income retained for use in the business:	Year 1972	Year 1971		
Balance at beginning of the year	$424,611,570	$380,834,378		
Net income for the year	96,428,525	88,814,692		
Total	521,040,095	469,649,070		
Cash dividends	48,037,500	45,037,500		
Balance at end of the year			473,002,595	424,611,570
TOTAL STOCKHOLDER'S EQUITY			948,002,595	899,611,570
TOTAL LIABILITIES, RESERVES AND STOCKHOLDER'S EQUITY			$12,145,040,798	$11,048,528,610

The above condensed balance sheet has been summarized from the financial statements appearing in the Annual Report of General Motors Acceptance Corporation as to which an unqualified opinion has been expressed by Haskins & Sells, independent public accountants.

STATISTICAL

Year	Net Sales	Net Income	Net Income as % of Sales	Dividends on Preferred Stock	Amount Earned on Common Stock		Dividends on Common Stock		Divide on Pref and Com Stocks a Net Inc
					Total	Per Share*	Total	Per Share*	
1953	$10,027,985,482	$ 598,119,478	6.0%	$12,928,312	$ 585,191,166	$2.24	$ 348,760,514	$1.33	60.5
1954	9,823,526,291	805,973,897	8.2	12,928,309	793,045,588	3.03	436,507,196	1.67	55.8
1955	12,443,277,420	1,189,477,082	9.6	12,928,305	1,176,548,777	4.30	592,245,497	2.17	50.9
1956	10,796,442,575	847,396,102	7.8	12,928,302	834,467,800	3.02	552,853,282	2.00	66.8
1957	10,989,813,178	843,592,435	7.7	12,928,300	830,664,135	2.99	555,453,812	2.00	67.4
1958	9,521,965,629	633,628,076	6.7	12,928,298	620,699,778	2.22	558,940,800	2.00	90.3
1959	11,233,057,200	873,100,149	7.8	12,928,296	860,171,853	3.06	561,838,126	2.00	65.8
1960	12,735,999,681	959,042,489	7.5	12,928,293	946,114,196	3.35	564,190,599	2.00	60.2
1961	11,395,916,826	892,821,444	7.8	12,928,292	879,893,152	3.11	707,383,013	2.50	80.7
1962	14,640,240,799	1,459,077,450	10.0	12,928,290	1,446,149,160	5.10	850,465,125	3.00	59.2
1963	16,494,818,184	1,591,823,058	9.7	12,928,288	1,578,894,770	5.56	1,135,809,405	4.00	72.2
1964	16,997,044,468	1,734,781,555	10.2	12,928,286	1,721,853,269	6.05	1,266,306,261	4.45	73.7
1965	20,733,982,295	2,125,606,440	10.3	12,928,282	2,112,678,158	7.41	1,496,812,657	5.25	71.0
1966	20,208,505,041	1,793,391,691	8.9	12,928,278	1,780,463,413	6.24	1,298,106,848	4.55	73.1
1967	20,026,252,468	1,627,276,076	8.1	12,928,276	1,614,347,800	5.66	1,084,355,349	3.80	67.4
1968	22,755,402,947	1,731,914,777	7.6	12,928,273	1,718,986,504	6.02	1,227,446,007	4.30	71.6
1969	24,295,141,357	1,710,695,164	7.0	12,928,272	1,697,766,892	5.95	1,227,429,173	4.30	72.5
1970	18,752,353,515	609,086,848	3.2	12,928,273	596,158,575	2.09	971,027,351	3.40	161.5
1971	28,263,918,443	1,935,709,493	6.8	12,928,272	1,922,781,221	6.72	972,443,676	3.40	50.9
1972	**30,435,231,414**	**2,162,806,765**	**7.1**	**12,928,270**	**2,149,878,495**	**7.51**	**1,273,066,301**	**4.45**	**59.5**

Factory Sales of Cars ar

Cars and Trucks Manufactured in the United States

Year	PASSENGER CARS						TRUCKS AND COACHES			TOTA Unite States
	Buick	Cadillac	Chevrolet	Oldsmobile	Pontiac	TOTAL	Chevrolet	GMC	TOTAL	
1963	480,082	164,651	2,302,458	504,853	625,688	4,077,732	482,769	101,189	583,958	4,661,6
1964	484,137	154,991	2,118,647	511,848	693,743	3,963,366	524,501	110,123	634,624	4,597,9
1965	651,792	196,420	2,585,014	649,530	858,915	4,941,671	618,944	135,865	754,809	5,696,4
1966	582,098	205,009	2,201,882	594,906	864,797	4,448,692	620,322	126,370	746,692	5,195,3
1967	575,001	212,576	1,919,687	553,993	858,448	4,119,705	548,219	130,720	678,939	4,798,6
1968	649,789	211,389	2,144,622	636,594	938,921	4,581,315	679,771	149,234	829,005	5,410,3
1969	713,894	266,489	2,002,074	668,108	774,707	4,425,272	684,452	149,928	834,380	5,259,6
1970	460,721	152,696	1,499,537	440,230	424,056	2,977,240	491,954	121,870	613,824	3,591,0
1971	751,865	277,465	2,324,099	775,137	728,551	4,857,117	738,208	171,813	910,021	5,767,1
1972	**688,665**	**277,454**	**2,301,604**	**807,372**	**703,029**	**4,778,124**	**766,840**	**195,476**	**962,316**	**5,740,4**

nd Consolidated Subsidiaries

SUMMARY

Net Income Retained for Use in the Business		Expenditures for Plant and Equipment (Excluding Special Tools)	Worldwide		At December 31			
					Common and Preferred Stockholders			
Total	Per Share*		Payrolls	Average Number of Employes	Number	Equity	Working Capital	Year
236,430,652	$ .91	$ 500,909,068	$2,676,044,049	585,602	494,632	$ 2,982,531,816	$1,290,420,661	1953
356,538,392	1.36	754,650,239	2,610,195,006	576,667	487,639	3,339,070,208	1,398,626,917	1954
584,303,280	2.13	608,121,546	3,127,145,514	624,011	565,408	4,255,055,724	2,088,174,944	1955
281,614,518	1.02	890,526,891	2,895,768,446	599,243	656,076	4,581,590,189	1,790,015,894	1956
275,210,323	.99	473,888,927	2,954,775,530	588,160	717,746	4,905,107,782	1,921,938,045	1957
61,758,978	.22	269,382,628	2,688,379,697	520,925	750,731	5,016,839,689	2,157,328,893	1958
298,333,727	1.06	319,940,202	3,083,759,866	557,218	786,744	5,371,011,318	2,624,108,800	1959
381,923,597	1.35	525,972,182	3,487,092,528	595,151	830,873	5,814,660,789	2,864,720,152	1960
172,510,139	.61	503,224,903	3,238,818,071	552,984	867,052	6,025,655,017	3,131,304,503	1961
595,684,035	2.10	645,113,381	3,894,873,691	604,718	1,059,225	6,650,971,621	3,610,075,503	1962
443,085,365	1.56	647,221,971	4,312,751,823	640,073	1,068,151	7,121,011,941	3,808,888,182	1963
455,547,008	1.60	929,588,476	4,592,481,476	660,977	1,186,885	7,599,015,311	3,739,647,071	1964
615,865,501	2.16	1,321,980,238	5,448,342,843	734,594	1,310,278	8,237,278,347	3,786,500,505	1965
482,356,565	1.69	1,188,054,246	5,559,741,677	745,425	1,417,955	8,726,102,975	3,709,147,192	1966
529,992,451	1.86	912,629,617	5,634,191,663	728,198	1,399,113	9,261,152,666	4,113,679,525	1967
491,540,497	1.72	860,189,501	6,540,142,678	757,231	1,371,795	9,756,809,763	4,390,235,128	1968
470,337,719	1.65	1,043,841,860	6,928,279,079	793,924	1,362,721	10,227,903,640	4,548,890,985	1969
(374,868,776)	(1.31)	1,134,164,761	6,259,840,549	695,796	1,357,604	9,853,770,622	3,267,590,973	1970
950,337,545	3.32	1,012,968,050	8,015,071,514	773,352	1,315,171	10,805,237,292	4,530,387,297	1971
876,812,194	**3.06**	**940,037,584**	**8,668,223,736**	**759,543**	**1,284,825**	**11,682,879,023**	**5,564,774,932**	1972

*In terms of present $1⅔ par value common stock

rucks, including export shipments

Cars and Trucks Manufactured Outside the United States								
	OVERSEAS PLANTS							
ANADIAN PLANTS	Australia	Brazil	England	Germany	All Other	Total	TOTAL Canada and Overseas	TOTAL SALES ALL SOURCES	Year
307,651	166,118	12,019	248,227	574,796	3,749	1,004,909	1,312,560	5,974,250	1963
293,367	170,212	13,232	342,873	678,278	18,526	1,223,121	1,516,488	6,114,478	1964
418,527	151,514	11,624	330,983	636,503	32,500	1,163,124	1,581,651	7,278,131	1965
356,407	154,584	15,923	275,383	653,421	66,236	1,165,547	1,521,954	6,717,338	1966
385,827	145,067	17,086	290,706	560,239	73,783	1,086,881	1,472,708	6,271,352	1967
423,579	168,363	24,894	329,047	654,584	76,127	1,253,015	1,676,594	7,086,914	1968
501,134	174,476	52,015	285,574	802,463	84,212	1,398,740	1,899,874	7,159,526	1969
290,927	189,565	70,112	269,797	807,074	89,954	1,426,502	1,717,429	5,308,493	1970
508,665	187,469	82,432	331,186	824,354	77,981	1,503,422	2,012,087	7,779,225	1971
459,128	**189,009**	**102,400**	**272,766**	**904,430**	**122,352***	**1,590,957**	**2,050,085**	**7,790,525**	1972

*In 1972, includes 27,920 units for Argentina, 32,214 units for Mexico, 23,001 units for South Africa and 39,217 units manufactured by Isuzu Motors Limited and marketed by General Motors

GENERAL MOTORS CORPORATION BOARD OF DIRECTORS

STEPHEN D. BECHTEL, JR.
President,
Bechtel Corporation
Director—3 Years

EUGENE N. BEESLEY
Chairman of the Board,
Eli Lilly and Company
Director—8 Years

LLOYD D. BRACE
Former Chairman of the Board,
The First National Bank of Boston
Director—13 Years

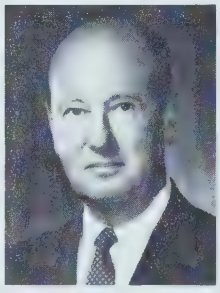
JOHN T. CONNOR
Chairman of the Board,
Allied Chemical Corporation
Director—7 Years

FREDERIC G. DONNER
Former Chairman,
Board of Directors
Director—31 Years

ELLIOTT M. ESTES
Executive Vice President
Joined Board in 1972

WALTER A. FALLON
President,
Eastman Kodak Company
Joined Board in 1972

OSCAR A. LUNDIN
Executive Vice President
Director—3 Years



JOHN A. MAYER
Chairman of the Board,
Mellon Bank N.A.
Director—4 Years

J. WESLEY MCAFEE
Chairman of the Board,
Union Electric Company
Director—10 Years

W. EARLE MCLAUGHLIN
Chairman and President,
The Royal Bank of Canada
Director—6 Years

JAMES M. ROCHE
Former Chairman,
Board of Directors
Director—10 Years

GEORGE RUSSELL
Former Vice Chairman,
Board of Directors
Director—17 Years

GERALD A. SIVAGE
President,
Marshall Field & Company
Director—3 Years

HARLLEE BRANCH, JR.
Former Chairman of the Board,
The Southern Company
Director—8 Years

CATHERINE B. CLEARY
President,
First Wisconsin Trust Company
Joined Board in 1972

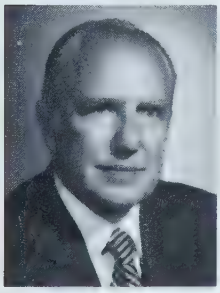
EDWARD N. COLE
President and
Chief Operating Officer
Director—11 Years

CHARLES T. FISHER, III
President,
National Bank of Detroit
Director—1 Year

RICHARD C. GERSTENBERG
Chairman, Board of Directors
and Chief Executive Officer
Director—5 Years

HARRY HELTZER
Chairman of the Board,
Minnesota Mining and
Manufacturing Company
Joined Board in 1972

JAMES R. KILLIAN, JR.
Honorary Chairman of the
Corporation, Massachusetts
Institute of Technology
Director—13 Years



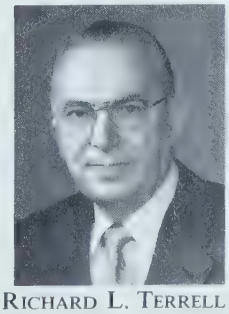
HOWARD J. MORGENS
Chairman of the Board,
The Procter & Gamble Company
Director—10 Years

CHARLES S. MOTT
Honorary Chairman, Board of
Trustees and Treasurer,
Charles Stewart Mott Foundation
Director—55 Years (1)

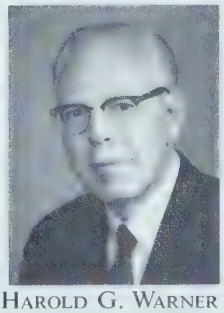
THOMAS A. MURPHY
Vice Chairman,
Board of Directors
Director—1 Year

THOMAS L. PERKINS
Chairman of the Trustees,
The Duke Endowment
Director—8 Years

LEON H. SULLIVAN
Pastor, Zion Baptist Church
of Philadelphia
Director—2 Years



RICHARD L. TERRELL
Executive Vice President
Joined Board in 1972



HAROLD G. WARNER
Executive Vice President
Director—5 Years

(1) Charles S. Mott was a director of General Motors Company, the predecessor of General Motors Corporation, from 1913 to 1917.

OFFICERS

Richard C. Gerstenberg
Chairman
Service—41 Years

Thomas A. Murphy
Vice Chairman
Service—35 Years

Edward N. Cole
President
Service—42 Years

EXECUTIVE VICE PRESIDENTS

Elliott M. Estes
Operations Staff
Service—38 Years

Oscar A. Lundin
Financial, Industry-Government Relations and Public Relations Staffs
Service—39 Years

Richard L. Terrell
Car and Truck and Body and Assembly Groups
Service—35 Years

Harold G. Warner
Special Assistant to the President
Service—45 Years

GROUP VICE PRESIDENTS

Reuben R. Jensen
Overseas Operations
Service—27 Years

Wallace E. Wilson
Automotive Components and Nonautomotive and Defense Groups
Service—35 Years

VICE PRESIDENTS AND GROUP EXECUTIVES

John Z. DeLorean
Car and Truck Group
Service—16 Years

Frank O. Riley
Automotive Components Group
Service—37 Years

Kenneth N. Scott
Body and Assembly Group
Service—37 Years

Roger B. Smith
Nonautomotive and Defense Group
Service—24 Years

VICE PRESIDENTS

John D. Baker
President, General Manager and Chief Executive Officer
General Motors of Canada Limited
Service—32 Years

Louis H. Bridenstine
Associate General Counsel
Service—36 Years

Harold W. Campbell
General Manager
Frigidaire Division
Service—39 Years

Martin J. Caserio
General Manager
Pontiac Motor Division
Service—35 Years

Paul F. Chenea
Research Laboratories
Service—6 Years

Robert W. Decker
General Manager
Fisher Body Division
Service—31 Years

Anthony G. De Lorenzo
Public Relations Staff
Service—24 Years

George R. Elges
General Manager
Buick Motor Division
Service—31 Years

Stephen H. Fuller
Personnel Administration and Development Staff
Service—1 Year

Harlow W. Gage
General Manager
General Motors Overseas Operations Division
Service—39 Years

Joseph E. Godfrey
General Manager
GM Assembly Division
Service—36 Years

Howard H. Kehrl
General Manager, Oldsmobile Division
Service—25 Years

Robert L. Kessler
Manufacturing Staff
Service—37 Years

James E. Knott
General Manager
Detroit Diesel Allison Division
Service—32 Years

Robert D. Lund
General Manager
Cadillac Motor Car Division
Service—27 Years

Robert F. Magill
Industry-Government Relations Staff
Service—18 Years

Alex C. Mair
General Manager
GMC Truck & Coach Division
Service—33 Years

Ross L. Malone
General Counsel
Service—6 Years

F. James McDonald
General Manager
Chevrolet Motor Division
Service—32 Years

William L. Mitchell
Design Staff
Service—33 Years

George B. Morris, Jr.
Industrial Relations Staff
Service—32 Years

Charles J. Scanlon
Pension Fund Investment Coordinator
Service—3 Years

Harold L. Smith, Jr.
General Manager
Electro-Motive Division
Service—27 Years

Ernest S. Starkman
Environmental Activities Staff
Service—2 Years

Henry W. Welch
Financial Staff
Service—39 Years

Frank J. Winchell
Engineering Staff
Service—33 Years

Mack W. Worden
Marketing Staff
Service—27 Years

STAFF OFFICERS

David C. Collier
Treasurer
Service—15 Years

Archie M. Long
Comptroller
Service—22 Years

Calvert Thomas
Secretary
Service—26 Years

COMMITTEES

FINANCE

Richard C. Gerstenberg
Chairman
Eugene N. Beesley
Lloyd D. Brace
Edward N. Cole
John T. Connor
Frederic G. Donner
Oscar A. Lundin
Howard J. Morgens
Thomas A. Murphy
Thomas L. Perkins
James M. Roche
George Russell

EXECUTIVE

Edward N. Cole
Chairman
Elliott M. Estes
Richard C. Gerstenberg
Oscar A. Lundin
Thomas A. Murphy
Richard L. Terrell
Harold G. Warner

AUDIT

J. Wesley McAfee
Chairman
Harllee Branch, Jr.
Charles T. Fisher, III
John A. Mayer
W. Earle McLaughlin
Leon H. Sullivan

PUBLIC POLICY

John A. Mayer
Chairman
John T. Connor
James R. Killian, Jr.
George Russell
Gerald A. Sivage

BONUS AND SALARY

Lloyd D. Brace
Chairman
Stephen D. Bechtel, Jr.
Eugene N. Beesley
Frederic G. Donner

NOMINATING

Eugene N. Beesley
Chairman
Lloyd D. Brace
John T. Connor
John A. Mayer
Howard J. Morgens
Thomas L. Perkins

ADMINISTRATION

Edward N. Cole
Chairman
John D. Baker
Martin J. Caserio
Robert W. Decker
John Z. DeLorean
George R. Elges
Elliott M. Estes
Harlow W. Gage
Richard C. Gerstenberg
Joseph E. Godfrey
Reuben R. Jensen
Howard H. Kehrl
Robert D. Lund
Oscar A. Lundin
Alex C. Mair
F. James McDonald
Thomas A. Murphy
Frank O. Riley
Kenneth N. Scott
Roger B. Smith
Richard L. Terrell
Harold G. Warner
Henry W. Welch
Wallace E. Wilson

GENERAL MANAGERS

Car, Truck, Body and Assembly Divisions

BUICK MOTOR DIVISION
Flint, Michigan

G. R. Elges,
General Manager
Service—31 years

Buick passenger cars; U.S. distribution of Opel passenger cars

CADILLAC MOTOR CAR DIVISION
Detroit, Michigan

R. D. Lund,
General Manager
Service—27 years

Cadillac passenger cars

CHEVROLET MOTOR DIVISION
Detroit, Michigan (Manufacturing or assembly operations in 13 cities)

F. J. McDonald,
General Manager
Service—32 years

Chevrolet passenger cars and trucks

FISHER BODY DIVISION
Warren, Michigan (Plants in 22 cities)

R. W. Decker,
General Manager
Service—31 years

Trim, metal and hardware fabricating and assembly of Fisher bodies

GM ASSEMBLY DIVISION
Warren, Michigan (Plants in 19 cities)

J. E. Godfrey,
General Manager
Service—36 years

Assembly of Chevrolet, Pontiac, Oldsmobile, Buick and Cadillac passenger cars and Chevrolet and GMC trucks

GMC TRUCK & COACH DIVISION
Pontiac, Michigan

A. C. Mair,
General Manager
Service—33 years

GMC trucks and buses

GENERAL MOTORS PARTS DIVISION
Flint, Michigan

L. G. Kalush,
General Manager
Service—25 years

Distribution of parts for Chevrolet, Pontiac, Oldsmobile, Buick, Opel and Cadillac passenger cars and Chevrolet trucks through warehouses in forty-two locations

OLDSMOBILE DIVISION
Lansing, Michigan

H. H. KEHRL,
General Manager
Service—25 years

Oldsmobile passenger cars

PONTIAC MOTOR DIVISION
Pontiac, Michigan

M. J. CASERIO,
General Manager
Service—35 years

Pontiac passenger cars

Automotive Components Divisions

AC SPARK PLUG DIVISION
Flint, Michigan

G. W. CHESTNUT,
General Manager
Service—40 years

Spark plugs; oil filters; instrument panels; fuel pumps; fuel filters; air cleaners; emission control systems; cruise control systems

CENTRAL FOUNDRY DIVISION
Saginaw, Michigan (Plants in 4 cities)

E. E. BRAUN,
General Manager
Service—43 years

Grey iron; malleable iron; ArmaSteel; nodular iron; aluminum and heat resistant alloy castings

DELCO ELECTRONICS DIVISION
Kokomo, Indiana (Plants in 2 cities)

H. G. RIGGS,
General Manager
Service—44 years

Auto radios; tape players; heater-air conditioning controls; semiconductor devices; integrated circuits; analog and digital systems; military electronics; inertial navigation and control systems and components

DELCO MORAINE DIVISION
Dayton, Ohio

N. L. GEBHART,
General Manager
Service—47 years

Automotive brake systems; engine bearings; powdered metal products; automatic transmission components

DELCO-REMY DIVISION
Anderson, Indiana (Plants in 5 cities)

P. W. HOUSE,
General Manager
Service—40 years

Starting, generating and ignition systems; switches; vacuum controls; batteries for passenger cars, trucks, buses, farm tractors and off-highway equipment

GUIDE LAMP DIVISION
Anderson, Indiana

C. W. DOBOS,
General Manager
Service—38 years

Car, truck and tractor lamps; lighting controls; mirrors; finished die castings; molded plastic parts; stampings

HARRISON RADIATOR DIVISION
Lockport, New York (Plants in 2 cities)

L. A. ZWICKER,
General Manager
Service—43 years

Car and truck radiators, defrosters, heaters, thermostats and air conditioners; heat exchangers

HYDRA-MATIC DIVISION
Ypsilanti, Michigan

J. S. GARLIC,
General Manager
Service—46 years

Hydra-matic automatic transmissions for cars, trucks, and military vehicles

INLAND DIVISION
Dayton, Ohio

T. O. MATHUES,
General Manager
Service—32 years

Weatherstrips; instrument panel pads; steering wheels; urethane seat pads; suspension ball joints; brake lining and hoses; flexible exterior trim; ice trays; engine and transmission mounts; air-conditioning hose

NEW DEPARTURE-HYATT BEARINGS DIVISION
Sandusky, Ohio (Plants in 3 cities)

P. B. ZEIGLER,
General Manager
Service—32 years

Ball, cylindrical, tapered and needle package bearings for automotive, aircraft and industrial uses; railroad journal boxes; sprag and roller clutches; transmission parts

PACKARD ELECTRIC DIVISION
Warren, Ohio

B. T. OLSON,
General Manager
Service—39 years

Automotive, appliance, marine and farm equipment wiring systems and components; fiber optics; magnet wire

ROCHESTER PRODUCTS DIVISION
Rochester, New York

J. R. WILSON, JR.,
General Manager
Service—30 years

Carburetors; diverter valves; emission control devices; steel tubing; cigarette lighters; locks; keys

SAGINAW STEERING GEAR DIVISION
Saginaw, Michigan

E. M. IVEY, JR.,
General Manager
Service—32 years

Power, manual steering; anti-theft, energy-absorbing steering columns; driver-adjustable steering; air pumps; front-drive axles; steering linkages; suspension units; prop shafts; ball-bearing actuators

UNITED DELCO DIVISION
Detroit, Michigan

M. C. MEEHAN,
General Manager
Service—32 years

Distribution of automotive service parts and equipment

Nonautomotive and Defense Divisions

DELCO PRODUCTS DIVISION
Dayton, Ohio (Plants in 2 cities)

E. P. CZAPOR,
General Manager
Service—25 years

Shock absorbers; electric motors and generators; hydraulic and electric controls, actuators, windshield wiper systems; automotive suspension units

DETROIT DIESEL ALLISON DIVISION
Detroit, Michigan (Plants in 2 cities)

J. E. KNOTT,
General Manager
Service—32 years

Diesel engines and heavy-duty transmissions for trucks, construction, lumbering, mining and petroleum equipment plus marine and industrial applications; gas turbines for military and commercial aircraft applications; industrial gas turbines for generator sets, construction equipment, plus marine and transportation applications; locomotive parts; precision bearings

DIESEL EQUIPMENT DIVISION
Grand Rapids, Michigan

C. O. DONLEY,
General Manager
Service—32 years

Fuel injectors; hydraulic and mechanical valve lifters; jet fuel nozzles; cold formed precision parts

ELECTRO-MOTIVE DIVISION
La Grange, Illinois (Plants in 2 cities)

H. L. SMITH, JR.,
General Manager
Service—27 years

Diesel locomotives; utility power generating plants; large marine and industrial diesel engines

TEREX DIVISION
Hudson, Ohio (Plants in 2 cities)

P. K. HOGLUND,
General Manager
Service—24 years

TEREX crawler tractors, scrapers, front-end loaders and haulers

Household Appliance Division

FRIGIDAIRE DIVISION
Dayton, Ohio

H. W. CAMPBELL,
General Manager
Service—39 years

Refrigerators; freezers; washers; dryers; ranges; dishwashers; food waste disposers; automobile air conditioner compressors and room air conditioners; commercial ice cube makers; commercial washers

Finance and Insurance Units

GENERAL MOTORS ACCEPTANCE CORPORATION
New York, New York

J. O. ZIMMERMAN,
President
Service—39 years

Wholesale and retail financing for dealers in GM passenger cars, trucks, buses and earthmoving equipment, and other GM products in the U.S., Canada and overseas

MOTORS INSURANCE CORPORATION
New York, New York

F. A. MINGLE,
President
Service—39 years

Fire, theft, comprehensive and collision insurance for passenger cars and trucks in the U.S. and Canada

MOTORS HOLDING DIVISION
Detroit, Michigan

WILLIAM HARVEY III,
General Manager
Service—24 years

Capital financing for retail dealers and distributors of GM products

Canadian Unit

GENERAL MOTORS OF CANADA LIMITED
Oshawa, Ontario (Plants in 6 cities)

J. D. BAKER,
President, General Manager and Chief Executive Officer
Service—32 years

Manufacture, assembly and distribution of GM cars, trucks, service parts and accessories; engines, transmissions, axles and other components; diesel locomotives; diesel engines; power generating plants; buses; TEREX products

Overseas Operations

GENERAL MOTORS OVERSEAS OPERATIONS DIVISION
New York, New York

H. W. GAGE,
General Manager
Service—39 years

Manufacture, assembly and distribution of GM products outside the U.S. and Canada

WALTER H. GUSSENHOVEN,
(General Motors Overseas Corporation)
General Director, Latin American Operations
Service—38 years

RALPH L. MASON,
(General Motors Overseas Corporation)
General Director, European Operations
Service—38 years

MAX E. WILSON,
(General Motors Overseas Corporation)
General Director, Australia, New Zealand, South Africa and East Asian Operations
Service—27 years

Major Overseas Car and Truck Manufacturing Operations

ADAM OPEL AG
Ruesselsheim am Main, Federal Republic of Germany (Plants in 3 cities)

A. A. CUNNINGHAM,
Managing Director
Service—25 years

Design and manufacture of Opel Kadett, Ascona, Manta, GT, Rekord, Commodore, Admiral and Diplomat passenger cars, light commercial vehicles

GENERAL MOTORS DO BRASIL S.A.
Sao Caetano do Sul (Sao Paulo), Brazil (Plants in 2 cities)

J. F. WATERS, JR.,
Managing Director
Service—21 years

Manufacture of Chevrolet Opala passenger cars, Chevrolet commercial vehicles and Frigidaire products; import of GM products

GENERAL MOTORS-HOLDEN'S PTY. LIMITED
Melbourne, Australia (Plants in 6 cities)

A. G. GIBBS,
Managing Director
Service—39 years

Design and manufacture of Holden Torana, Monaro, Premier, Kingswood, Belmont and Statesman passenger cars, Holden light commercial vehicles; assembly of imported vehicles; import of GM products

VAUXHALL MOTORS LIMITED
Luton, England (Plants in 3 cities)

A. D. RHEA,
Managing Director
Service—25 years

Design and manufacture of Vauxhall Viva, Firenza, Victor, Ventora and VX 4/90 passenger cars, Bedford commercial vehicles

Other Overseas Operations

Africa

GENERAL MOTORS SOUTH AFRICAN (PTY.) LIMITED
Port Elizabeth, Republic of South Africa

Manufacture of Ranger, Chevrolet and Opel passenger cars; assembly of imported vehicles; import of GM products

GENERAL MOTORS ZAIRE S.A.R.L.
Kinshasa, Zaire

Assembly of imported vehicles; import of GM products

Asia

GENERAL MOTORS MALAYSIA S.B.
Johore Bahru, Malaysia

Assembly of imported vehicles

GM PHILIPPINES MANUFACTURING CORPORATION
Alabang (Rizal), Philippines

Manufacture of automotive components

GENERAL MOTORS THAILAND LIMITED
Bangkok, Thailand

Import of GM products

Europe

GENERAL MOTORS AUSTRIA GES.M.B.H.
Vienna, Austria

Import of GM products

GENERAL MOTORS CONTINENTAL
Antwerp, Belgium;
Rotterdam, Netherlands

Assembly of imported vehicles; import of GM products

GENERAL MOTORS DEUTSCHLAND GMBH
Wiesbaden, Federal Republic of Germany

Import of GM products

GENERAL MOTORS FRANCE
Gennevilliers (Seine), France

Manufacture of automotive components; import of GM products

GENERAL MOTORS GMBH
Berlin, Federal Republic of Germany

Manufacture of engine bearings

GENERAL MOTORS INTERNATIONAL A/S
Copenhagen, Denmark

Assembly of imported vehicles; import of GM products

GENERAL MOTORS ITALIA S.P.A.
Rome, Italy

Import of GM products

GENERAL MOTORS LIMITED
Dunstable, England (Plants in 5 cities)

Manufacture of Frigidaire products and automotive components; import of GM products

GENERAL MOTORS LUXEMBOURG S.A.
Bascharage, Luxembourg

Manufacture of TEREX off-highway earthmoving equipment

GENERAL MOTORS NORDISKA A.B.
Stockholm, Sweden

Import of GM products

GENERAL MOTORS NORGE A/S
Lillestrom (Oslo), Norway

Import of GM products

GENERAL MOTORS DE PORTUGAL, LIMITADA
Lisbon and Azambuja, Portugal

Assembly of imported vehicles; import of GM products

GENERAL MOTORS SCOTLAND LIMITED
Motherwell, Scotland
(Plants in 2 cities)

Manufacture of TEREX off-highway earthmoving equipment

GENERAL MOTORS STRASBOURG S.A.
Strasbourg, France

Manufacture of automatic transmissions

GENERAL MOTORS SUISSE S.A.
Bienne, Switzerland

Assembly of imported vehicles; import of GM products

SUOMEN GENERAL MOTORS OY.
Helsinki, Finland

Import of GM products

Latin America

GENERAL MOTORS ARGENTINA S.A.
San Martin (Buenos Aires), Argentina
(Plants in 2 cities)

Manufacture of Chevrolet passenger cars and Chevrolet commercial vehicles; import of GM products

GENERAL MOTORS DE MEXICO, S.A. DE C.V.
Mexico City, Mexico
(Plants in 2 cities)

Manufacture of Chevrolet passenger cars and Chevrolet commercial vehicles; import of GM products

GENERAL MOTORS TEREX DO BRASIL S.A.
Belo Horizonte, Brazil

Assembly of TEREX off-highway earthmoving equipment

GENERAL MOTORS URUGUAYA S.A.
Montevideo, Uruguay

Assembly of imported vehicles; import of GM products

GENERAL MOTORS DE VENEZUELA, C.A.
Caracas, Venezuela

Assembly of imported vehicles; import of GM products

New Zealand

GENERAL MOTORS NEW ZEALAND LIMITED
Wellington, New Zealand

Assembly of imported vehicles; manufacture of Frigidaire products; import of GM products

United States

GENERAL MOTORS INTERAMERICA CORPORATION
New York, New York

Distribution of GM products in western hemisphere areas not served by plants or warehouses

GENERAL MOTORS OVERSEAS CORPORATION
New York, New York

Management services

GENERAL MOTORS OVERSEAS DISTRIBUTION CORPORATION
New York, New York

Distribution of GM products in overseas areas not served by plants or warehouses

Associated Companies

ISUZU MOTORS LIMITED
Tokyo, Japan (34.2% owned)

Design and manufacture of Isuzu 117, Bellet and Florian passenger cars, Isuzu commercial vehicles, engines for marine and industrial applications

BANGCHAN GENERAL ASSEMBLY COMPANY LIMITED
Bangkok,Thailand (49% owned)

Assembly of imported vehicles

GM ALLISON JAPAN LIMITED
Tokyo, Japan (50% owned)

Import of gas turbine engines and heavy-duty automatic transmissions

GENERAL MOTORS KOREA COMPANY, LTD.
Seoul, Korea (50% owned)

Assembly of imported vehicles

GENERAL MOTORS PHILIPPINES, INC.
Manila, Philippines (60% owned)

Assembly of imported vehicles

This beautiful new Frigidaire-equipped kitchen features (from left to right) a three-door Custom Imperial Side-by-Side refrigerator-freezer, Trash Compactor, Custom Imperial Built-In dishwasher, Ceramatop range and a Custom Deluxe washer and electric dryer. All appliances shown are finished in Poppy Red.

Typical of a completely new line of TEREX off-highway haulers is this Model 33-05, a 28-ton unit. It is shown here being loaded by a TEREX 72-71 Pivot Steer front-end loader equipped with a seven-yard bucket.

GENERAL MOTORS CORPORATION
DETROIT, MICHIGAN 48202

Since 1953, GM's 30 Training Centers throughout the United States have provided General Motors dealers, sales and service managers, salesmen, accountants, mechanics and other service employes with over 77 million man-hours of instruction with the goal of insuring the complete satisfaction of General Motors customers. Two important factors led General Motors to establish the Training Centers—adequate numbers of trained mechanics were needed to service the nation's cars and trucks and the continued improvement in performance, comfort and reliability increased the technical complexity of the vehicles and their components.

AR34

GENERAL MOTORS CORPORATION

1972 REPORT ON

PROGRESS IN AREAS OF PUBLIC CONCERN

GM TECHNICAL CENTER • WARREN, MICHIGAN

February 10, 1972

GENERAL MOTORS CORPORATION
PROGRESS IN AREAS OF PUBLIC CONCERN

On February 10, General Motors held a conference at our Technical Center in Warren, Michigan to report our progress in several areas of public concern. Attending were representatives of some of our large institutional investors, including universities and foundations.

We thought you might be interested in the report of this conference. We think it tells a story of steady, determined effort on the part of your Corporation. The conference highlights GM's progress in many areas, but it also notes that some problems continue to be unresolved. A long hard look at the cost of further progress in the light of the benefits that might be achieved is emphasized.

The conference had a two-fold purpose: to explain to these investors what we were doing, and to elicit from them their individual appraisals of our efforts and whatever suggestions they might have to help us further our progress.

As you will see, we listened and we learned. We *listened* to all the views that were expressed. And we *learned*, from the conference and the comments we received later, a great deal of what was on the minds of our stockholders, the owners of our business. We are always mindful that it is the resources of these men and women and institutions that we are investing to help achieve these great national objectives.

We send this report to you in the hope that you, too, will share your views with us.

R. C. Gerstenberg

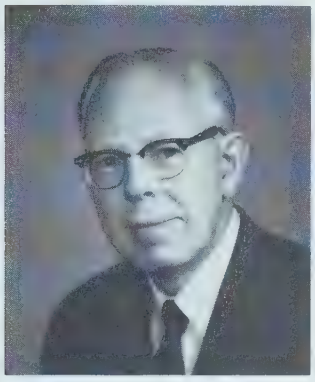
Chairman

PRESENTATIONS

INTRODUCTION

Harold G. Warner

HAROLD G. WARNER *began his General Motors career in 1927 on the assembly line at Cadillac Motor Car Division. The following year he entered General Motors Institute as a Cadillac-sponsored cooperative student. After graduation from GMI in 1932, he held various engineering positions at Cadillac, primarily in the manufacturing area. In 1949 he was placed on special assignment with GM Overseas Operations Division and served as assistant manager of forward planning for an expansion and modernization program at Vauxhall Motors, Ltd. in England. He returned to Cadillac in 1950 and held successive positions of increasing responsibility, culminating with his appointment as General Manager in 1960, at which time he also was elected a Vice President of GM and appointed a member of the Corporation's Administration Committee.*



In 1966, Mr. Warner was appointed Group Executive in charge of the Body and Assembly Group, and the following year was placed in charge of the Car and Truck Group. In 1968, he was elected a Director of the Corporation, a member of its Executive Committee, and appointed to his present position of Executive Vice President in charge of the Operations Staff.

In addition, Mr. Warner also serves on seven of the Corporation's top Policy Groups—Marketing, Engineering, Research, Overseas, Personnel Administration and Development, Industrial Relations, and Public Relations.

Mr. Warner is associated with a number of business, educational, professional, and civic organizations. He is a regional chairman of the National Alliance of Businessmen and is active in the NAB program for hiring the hard-core unemployed, many of whom are from minority groups. He currently serves on the boards of directors of the Detroit United Foundation, Junior Achievement, Oakland University, and Alma College.

We are particularly pleased to be your hosts here at the General Motors Technical Center. Both the facilities and, we believe, the people are unique in the automobile industry—or nearly any industry for that matter. Many of tomorrow's problems are being solved here today. In this one-half square mile, we have concentrated GM's corporate design, research, engineering, manufacturing development, and environmental activities. Nearly 6,000 General Motors engineers, scientists, technicians, and supporting personnel work in this complex. A majority of the speakers today are either staff executives or project leaders from the Technical Center.

Among GM stockholders and interested friends, you not only have the expected interest in corporate earnings, but you also represent a large number of individuals with increasing concern for social issues and the environmental and safety progress of GM products. We fully appreciate your interests, concerns and responsibilities, and we are prepared to give you a thorough briefing in those areas.

Some of you were with us last year. We are pleased to see you again. For you, this will be an updating of our plans and progress.

But most of you are making your first visit to the Technical Center. We extend a special welcome to you. From the reactions of other first-time visitors, we are confident that you will see and hear many things of interest to you and your organizations.

The Technical Center is an investment in both General Motors' future and that of our country. We think the return on investment has already been significant, as seen in GM products on American highways today.

Progress has been made in safety and emission control, but we believe the "return" *will* and *must* increase to meet new corporate responsibilities and achieve new objectives.

Some projects are within a year or two of the marketplace or application in our manufacturing operations. Others may not have a commercial application for ten or more years—if then.

Some Technical Center projects make special contributions to the well-being of people and communities. In cooperation with the medical profession, specialists at the Technical Center have had a part in developing the mechanical heart, an electronic heart-sound detector, a centri-filmer for sterilizing blood plasma, and a remotely controlled heart catheter. They have helped with an electric pacer for city traffic, made studies and offered

solutions on mass transit problems and participated in many other community projects.

This Technical Center was dedicated in May of 1956. In one sense it has never been finished, and it probably never will be. There is always a construction project underway—either on the drawing boards or in the hands of a contractor. These continuing changes reflect General Motors' growth, but more significantly they reflect the changing nature of our products and our goals.

From the beginning, the Technical Center has been the home of the Styling Staff, Engineering Staff, Research Laboratories, and the Manufacturing Development Section of the Manufacturing Staff. As times have changed, we have added buildings involved with isotopes, computers, and other new technology. Individual Staff activities have been re-oriented strongly toward safety and emissions. Last year we organized a new staff primarily charged with these responsibilities and called it the Environmental Activities Staff.

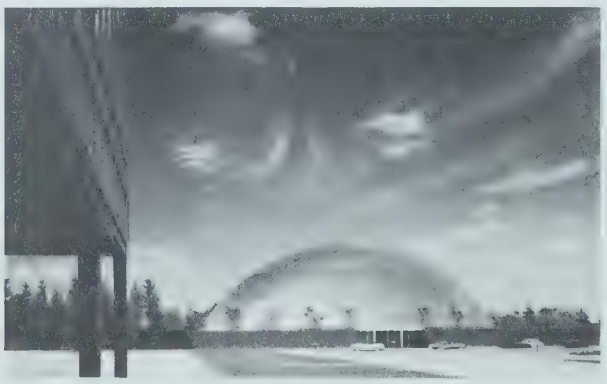
You will have a chance to visit some of our facilities, but even more important, you will have an opportunity to meet a score or more of our technical people and hear firsthand about their projects in areas of public concern. We are particularly proud of their competence and their dedication to advancing the objectives of General Motors and solving problems of national importance.

When these facilities were dedicated, Charles F. Kettering, who was the first vice president in charge of the GM Research Laboratories, said: "Ideas are developed in the mind. If we took all the people away, it would be obvious that nothing would come out of the Technical Center."

This is still true. GM's future depends on many of the people you will meet and hear today. We believe it is in good hands and that much, much more will "come out of the Technical Center."

Overall Aerial View of Technical Center

Water Tower and Research Laboratories



Styling Auditorium

TWO MYTHS AND A PARADOX

Edward N. Cole

EDWARD N. COLE, *President and Chief Operating Officer of General Motors and Chairman of its Executive and Administration Committees, joined GM in 1930 as a General Motors Institute student sponsored by the Cadillac Motor Car Division. Because of his talents, he was taken from GMI before graduation by Cadillac and assigned to a special engineering project. (He was granted a work-delayed degree from GMI in 1952.) He progressed through various engineering positions at Cadillac, becoming Chief Engineer in 1946, Works Manager in 1950, and Manager of Cadillac's Cleveland Tank Plant the following year.*

In 1952, Mr. Cole was named Chief Engineer of Chevrolet Motor Division and four years later was appointed General Manager of Chevrolet and Vice President of General Motors. In 1961 he became Group Executive in charge of the Car and Truck Divisions and was appointed a member of GM's Board of Directors. He was elected an Executive Vice President in 1965 and placed in charge of all GM Staff activities. He was serving in that position when elected to the presidency in 1967. Mr. Cole serves as a member of the Finance Committee in addition to being a member of GM's other top policy-making Committees.

Mr. Cole is a member of a number of business, professional, and civic organizations and is current chairman of the National Industrial Pollution Control Automotive Sub-Council of the U.S. Department of Commerce and a member of the U.S. Secretary of State's Advisory Committee for the 1972 U.N. Conference on the Human Environment.

For much of the day you will be hearing about technology. To help orient you for the talks you will hear and the things you will see, I would like to talk for a few minutes about two myths and a paradox.

In recent years it has been popular to talk about the rapidity of change—particularly scientific change. It has been said that scientific knowledge doubles every ten years. No doubt it does. One writer has predicted that the rapid change of products and processes will obsolete the work of 60 million Americans in the next generation. Again, this probably is true.

Still others have pointed out that we are shortening the time from scientific breakthrough to market application. Photography took 112 years from invention to application. The telephone took some 56 years . . . radio 35 . . . radar 15 . . . television 12 . . . and transistors 5 . . . but laser rays made it from the laboratory to application in only 10 months.

The First Myth

If all this is true—and it is—doesn't this mean that new technology in the automobile industry can move in months from the laboratory to the assembly plant and the production of 8½ million cars a year in the United States?

Absolutely no . . . and that is the first myth. Automotive breakthroughs cannot be translated quickly into production cars. Production lead time, intensive testing, customer acceptance, and cost-benefit analysis determine what and when innovations can be safely and effectively added.

Automotive developments are coming fast. But unlike other products, they apply to very complex products involving safety, health, and the commerce and life of communities. They apply to millions of vehicles requiring a high degree of uniformity, reliability and long life. Both because of the products, their volume and nature of their materials, the manufacturers are faced with expensive tooling and space and manufacturing problems. These characteristics make every automotive decision a major investment and every investment a commitment for several years.

The automobile industry is highly competitive. A wrong engineering decision may affect not only one model, but by creating or destroying customer loyalty, it may affect product success for several years. Every change must go through careful cost-benefit analysis—establishing the priorities for the customers' dollars.

Currently, the industry is in the process of developing an energy absorbing bumper. In the customers' interest, very detailed studies have been made —such as, the nature and frequency of various

types of accidents, the cost of accident repair, and, of course, the costs of the bumper systems themselves. These have been related to the savings that motorists might reasonably expect from reduced insurance premiums. The cost-benefit results are interesting.

The owner of a car with a bumper system that provides protection to all safety related components at front and rear barrier impact speeds of 5 mph (as required by Federal regulations for 1974 models), would have to wait over 8 years to recover his bumper investment—IF the premium is reduced 10 percent, or over 5 years IF the premium is cut 20 percent.

Taking it one step further, if legislation should require a damage-free bumper system that could absorb a 10 mph crash into a barrier on the front and rear—and this is advocated by some state legislators—the average motorist would probably never recover his additional investment through insurance savings alone, *even if he drove his car for 10 years.*

There is another reason why it is a myth to expect automotive developments to be instant additions to automobiles.

The automobile industry depends not only on *research* and *development* but also on long and careful *demonstration* before cars are put in the hands of customers. This is a necessity because of the nature of the products, their use, and the requirements of Federal standards. Customers do not want to be guinea pigs for research—and they shouldn't be.

New developments must work not only under the controlled conditions of the laboratory, but also in the sub-zero of northern Montana winters and in the high temperatures and high humidity of Florida. They must be engineered and tested for a variety of drivers and for frequently casual or no maintenance.

The timing of Federal standards does not always take into consideration all the essential time factors involved in the development, testing, production, and use of innovations demanded of the automobile industry by those standards.

First, there is the time it takes to develop the new equipment from engineering specifications to laboratory performance under carefully controlled conditions.

Then, after the new device has been tested and retested and refined sufficiently for production, the machinery has to be ready to mass-produce it. Some Federally-required innovations are highly sophisticated items—emission control systems, for example, and, some day, perhaps, air cushions. They require sophisticated production equipment, which takes time to develop, build, and teach people to operate.

Back in the days when we had more control over the lead time preceding the introduction of new equipment, we could phase it into production. Innovations like power brakes and power steering were first produced at lower volume levels since they were available only as options on certain models. We could proceed with care and caution. Our "learning curve" was more gradual. But today, it is greatly accelerated.

Crash programs can shorten the lead time preceding mass-production of some items, but they can also increase the risk of error, especially with complex equipment. In our development work on air cushions, for example, we are very conscious of our liability as a manufacturer. When you are dealing with explosive devices—which air cushions are—you want to know the answers to a lot of touchy questions, such as:

- What is the life expectancy of these systems?
- What will happen when the vehicle equipped with an air cushion is scrapped?
- What is the manufacturer's liability if the cushion deploys and causes an accident? Or if it doesn't deploy quickly enough?

Our first concern, of course, is for the safety of our customers, but, if we are required by law to provide certain equipment to the public at a certain time, we would be remiss if we did not very seriously consider our risks and liabilities as the manufacturer of that equipment.

Our risk and liability considerations are important in the emissions control area as well as in safety. For example, the Clean Air Act, as amended in 1970, requires that emissions control systems be effective for five years or 50,000 miles. There is a recall provision for cars that fail to meet these regulations for the required period—*provided that they have been maintained in accordance with the manufacturer's recommendations.*

To protect ourselves against excessive risk, it will be necessary for us to recommend that these cars be maintained as if they were being operated

by owners who give them the hardest use—the two or three percent who drive at the highest speeds, over the worst roads, in the most severe weather.

This will not please the average owner. We have no alternative under the provisions of this law as it stands today, however, because we have not found a way to simulate all the various kinds of use and misuse that a car will get over a five-year period. We can run a car 50,000 miles in about three and one-half months, operating around the clock. But we just do not know how to give a car five years of all kinds of driving, weather, road conditions, and maintenance in a relatively short test period.

The Second Myth

There is a second myth I would like to mention. Several years ago an idea was widely promoted that there are two worlds—a world of science and technology on one hand and a world of humanism on the other. The two worlds have two languages and very different objectives and goals.

There is a grain of truth in that theory, but only a grain. In industry, the two world concept is a myth. The worlds of science and non-science come together in the common objectives of a company. Industry takes the theory of the laboratory and translates it into the practical hardware of the marketplace. It provides motivation for individuals with a variety of talents. They do talk the same language—when they have the common goals of improved service and products for customers.

We do recognize that there has been a problem of language, but it is not so much within a company, as it is between the progress of technology and the understanding of the public. Frequently, technology has moved faster than the public has been able to keep up with it.

For example, judging by our mail and the press, many still feel that the car is the major contributor to air pollution. They believe that the nation's air pollution problem would disappear overnight if we turned off the ignition of every car, truck, and bus in America. Careful studies by several competent researchers show that this is not true. If all cars, trucks, and buses were parked, we would still have 60 percent of our air pollution problem measured by weight, and about 90 percent of the problem as it relates to health. The public has not realized that the automobile's percent of the air pollution problem has been reduced—even though the car population has increased.

These points have been emphasized in literature and on public platforms, but we continue to have a language problem or, perhaps more accurately, a credibility problem. More than ever in the history of our country we need the factual, objective findings of technology as a basis of discussion and decision. To this extent there is a language problem.

The Paradox

In addition to the two myths of instant progress and two worlds, there is also an important paradox that we must recognize. Technology is both a cause and a cure—a saint and a sinner, depending on how it is directed. Critics have pointed out that technology has polluted our environment. It has wastefully used our natural resources, and created an impersonal, mechanistic society.

No one would deny that in many cases this has been true.

As a result, some critics have even insisted that we return to a simpler life . . . that we turn back the clock to the agrarian society of 100 years ago, reduce our consumption and Gross National Product, and set a goal of zero growth.

Do they want to go back to the days before the Salk vaccine for the prevention of polio? Do they want to do without modern bathrooms, telephones, electricity or other modern conveniences? Would they be willing to go back to the hand-cranked car with two-wheel brakes and boiling radiator, or even further back to the horse and wagon? The answer is not to stop technology but to redirect it with new environmental assignments. Technology can do the job. It can protect and restore our environment, and it can do it to whatever degree the public and the customer want it done. Or, putting it more accurately, to the degree they are willing to pay the cost.

Technology, in itself, is neither good nor bad. It does what people direct it to do. Today you will hear about some of GM's directed technology, directed for the improvement of our environment as well as the benefit and convenience of GM customers.

AUTOMOTIVE AND INDUSTRIAL EMISSION CONTROL

Ernest S. Starkman

ERNEST S. STARKMAN, *prior to his appointment as Vice President in charge of the Environmental Activities Staff in April 1971, was professor of mechanical engineering, University of California, Berkeley and assistant vice president for the Statewide University. Before assuming these positions, he had been chairman of the Thermal Systems Division of the College of Engineering.*

Mr. Starkman received a B.S. degree in 1942 and a M.S. degree in 1945 from the University of California at Berkeley. He held positions in private industry before returning to the University to assume teaching and administrative positions. He became a professor there in 1960.

Mr. Starkman has authored over 100 technical papers on engine fuels, lubricants, and combustion and received the Society of Automotive Engineers' Horning Memorial Award and Medal in 1959 and the Colwell Award in 1968 for papers relating to engine combustion. He served as chairman of the Technical Advisory Committee to the State of California Air Resources Board from 1968 to 1971 and was chairman of the Advisory Committee on Advanced Power Systems to the Council of Environmental Quality. He is presently a member of the Technical Advisory Board, U.S. Department of Commerce.

Mr. Starkman holds membership in numerous engineering and honorary societies. He was named Professor Emeritus in the University of California's Department of Mechanical Engineering, Berkeley Campus, in April 1971.

A year ago at this time I attended the first of these Conferences. On that occasion I was representing the Statewide University of California. It was shortly thereafter that I joined General Motors. My present position was created when GM decided that the Corporation's environmental activities could function better on a centralized instead of decentralized basis. This resulted in the formation of the Environmental Activities Staff, which was accomplished principally by centralizing already existing functions in the safety, pollution, and product assurance areas.

Environmental Activities Staff Responsibilities

A considerable number of the environmental subjects that were covered for you last year have now been consolidated within the functions of the Environmental Activities Staff (Figure 1).

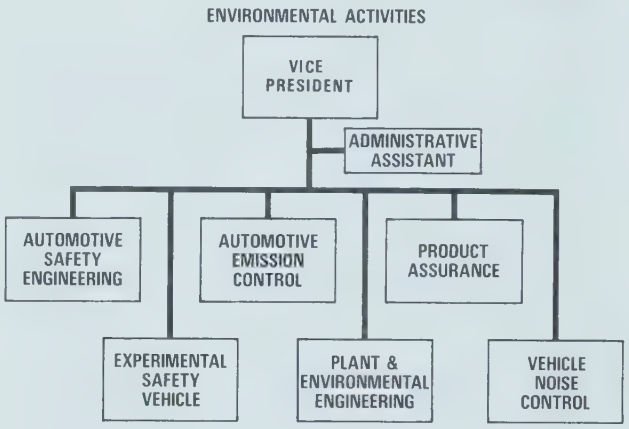


Figure 1

Automotive Safety Engineering will be discussed later this morning. You will also see an Emission Control hardware display, and the Experimental Safety Vehicle. In the interest of time, I won't discuss Product Assurance and Vehicle Noise Control. I will, however, attempt to bring you up to date in the areas of Automotive Emissions and Plant and Environmental Engineering.

The primary responsibilities of the Environmental Activities Staff are to:

1. Coordinate engineering development in the areas of emission control, vehicle safety, and the experimental safety vehicle.
2. Serve as the Corporation's spokesman in areas relating to the performance of products and operation of facilities in the environment.
3. Coordinate activities involving industrial pollution control.

4. Maintain the capability to audit and statistically evaluate product reliability and quality.
5. Serve as the technical interface with regulatory agencies.
6. Monitor and coordinate vehicle noise control efforts as they relate to legislative trends.

Part of our mandate is to improve the Corporation's technical image with the public and with the government, and particularly to develop better relationships with the regulatory agencies. By this I mean, we hope to develop a "day to day" dialogue between our engineers and scientists, and members of these agencies. We hope to set our sights more accurately regarding our future products, as they may be affected by regulations. We hope to develop a mutual understanding of each others problems, not only so that more precise goals may be set, but hopefully so that there will be adequate lead time in which to attain the specified goals.

If we do our jobs effectively, there will also be improved dialogue between our function and the public—the stockholder—and within our own management at the staff and divisional levels.

My decision to leave academia was not an easy one. My joining General Motors was based in no small part on the conviction that this organization recognized that strong action must be taken to clean up the environment. I believed that GM wanted to do its share, and was striving precisely in that direction. However, it is vital that not only GM, but the nation as a whole move toward the realization of future objectives with rational and reasonable solutions. Unfortunately, it appears to me that reason and rationale are sometimes all too meagerly in evidence. The most salient present example that I can think of is the manner by which the Clean Air Amendments of 1970 were promulgated and made into law.

This Act requires that by 1975-76 there must be an arbitrary 90 percent reduction from the 1970-71 levels in the three main auto pollutants: hydrocarbons, carbon monoxide, and oxides of nitrogen. Since existing regulations had in 1970 already reduced the first two of these pollutants, this meant that, to meet the law, our vehicles by 1975 and 1976 would have reductions of 97 percent hydrocarbons; 96 percent carbon monoxide; and 92 percent oxides of nitrogen, from the uncontrolled (1960) levels.

Auto Air Pollution Picture Today

I would like to spend the first few minutes discussing the present state of the contribution which automobiles make to the nation's air pollution problem. For this purpose, I would like to show you some material taken from the January 1, 1972 report of the National Academy of Sciences Committee on Motor Vehicle Emissions.

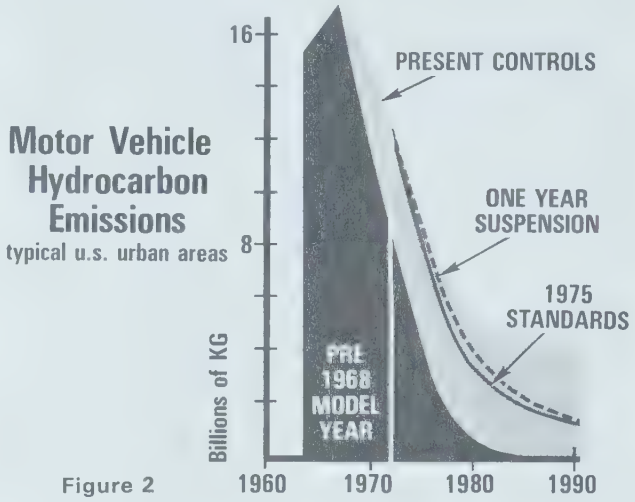


Figure 2

Figure 2 shows curves dealing with hydrocarbon emission rates from motor vehicles. As indicated, atmospheric levels of automotive-related hydrocarbons have decreased 28 percent since the peak in 1968 due to present emission controls which have been installed in cars. The solid line indicates the reductions which will result, should vehicles be able to meet the 1975 standards. The dashed line shows the effect on the environment of a one-year delay in meeting the 1975 requirements.

Carbon monoxide levels present a very similar curve (Figure 3). There has been a 17 percent de-

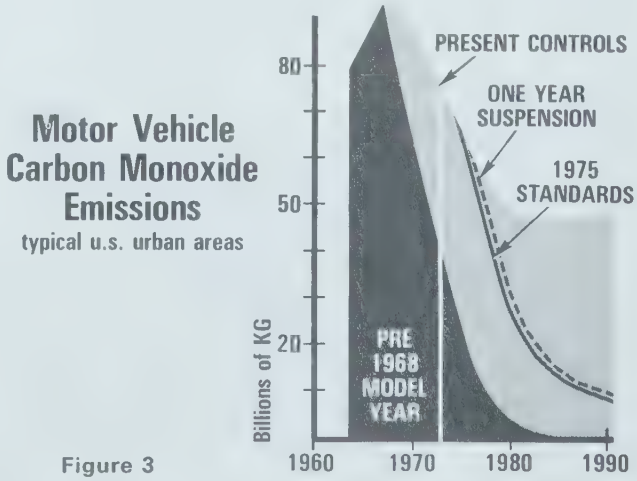


Figure 3

cline from the 1968 peak to the present time. Again, the environmental effect on total emissions of a one-year suspension appears to be small.

As the curves in Figures 2 and 3 suggest, reductions in automotive-related hydrocarbons and carbon monoxide will continue in the future, whether or not the 1975 control levels are considered. The rate of decrease until about 1980 depends primarily on the retirement of pre-1968 vehicles from use.

These decreases in atmospheric carbon monoxide and hydrocarbons are confirmed by publications of the Los Angeles County Air Pollution Control District, which show that in the Los Angeles Basin present levels of vehicular-contributed hydrocarbons are down 36 percent from the 1966 peak, and carbon monoxide is down 25 percent from its 1966 peak.

The difference between the national and California figures reflects the two-year earlier application of exhaust controls to California cars.

Because controls for oxides of nitrogen have only recently been installed on new cars nationwide, a similar downward trend in that pollutant has not yet taken place. However, the peak atmospheric level is expected to occur this year (Figure 4). The controls for oxides of nitrogen, which have been installed on recent models of GM cars, reduce the emissions of this pollutant by about 30 percent.

MOTOR VEHICLE OXIDES OF NITROGEN EMISSIONS (TYPICAL U.S. URBAN AREAS)

Figure 4

The reported downtrend in air pollution alerts experienced by Los Angeles in 1971 is additional indication that the situation there has been improved. It is not unreasonable to expect that the same trend is similarly taking place across the nation. This is encouraging, but we do not wish to leave the impression that the air pollution problem has been completely resolved—either in Los Angeles or in other cities of the nation. We do, however, wish to call your attention to the fact that significant progress is being made in cleaning up motor vehicle emissions, and thus the atmosphere.

But our problems are not limited to the areas of communication and credibility. We continue to hear quoted the figure of 60 percent as the automotive contribution to the national air pollution problem. The Environmental Protection Agency now has corrected this figure to approximately 40 percent, on a total tonnage basis. It is now recognized by experts in the academic world that a more accurate measure of the motor vehicle contribution should be based on relative effects on health and plant life. The most recent technical publications incorporating health and plant damage—together with tonnage—show that the automobile is responsible for about 10 percent of the nation's problem. They and we realize, of course, that this varies from one urban area to another, and indeed some areas of stress may at the present time be affected by much more than the 10 percent national figure. It still remains, however, that the most affected areas, such as Los Angeles, even on the most pessimistic basis, do not suffer from the automobile anything like the "over 90 percent" sometimes quoted.

At the present, GM feels that it has already made important progress in reducing automotive emissions (Figure 5). We have been trying to communicate the fact that hydrocarbon emissions have already been reduced by 80 percent, carbon monoxide by about 65 percent, and oxides of nitrogen by about 30 percent, when 1971 cars in the hands

AUTO EXHAUST EMISSIONS

% reductions from uncontrolled levels

	1975-76 Requirements	Today*
HYDROCARBONS	97%	80%
CARBON MONOXIDE	96%	65%
OXIDES OF NITROGEN	92%	30%**

Figure 5

*June, 1971
**Based on 1970 Federal Test

of the customers are compared to 1960 models. Beginning with 1970 models, nitrogen oxide control systems were incorporated into GM cars, even in advance of Federal requirements.

Unfortunately, the public cannot see these reductions and we continue to face the difficulty of convincing the public of progress in vehicular emission control.

The atmospheric improvements resulting from the levels of control already applied to the automobile have not been without penalty. Many who have purchased recent model cars have experienced a decrease in the driving response and, sometimes, difficulty in starting. This adverse effect on driveability, as we call it, is an unfortunate consequence of modifications made in order to decrease the concentration of pollutants which emit from the exhaust pipe.

While the individual vehicle owner usually does not measure precisely the fuel consumption of his vehicle, I can confirm what is perhaps your own experience—that the public is paying a penalty in increased fuel usage for the same vehicle applications.

This result is not pleasing to any manufacturer—and certainly not to the car buyer. Indeed, GM has had to discontinue some of its engine-vehicle combinations after making modifications to emissions control systems. In our opinion, driveability and fuel economy of such combinations would not have been acceptable to the public.

Clean Air Amendments

When the 1970 Clean Air Amendments were adopted by the Congress, the action caught the technical world by surprise. I was among those who could be so classified, because prior to joining GM, I spent a large part of my time working with Federal and local regulatory agencies. In that advisory function in 1970, it was my viewpoint that the timing of the then existing 1975 and 1980 vehicle emission levels was justifiable. There was and is a need to clean up the atmosphere. I believed that it was technologically feasible of accomplishment in the time frame specified.

The effective advancement to 1975 of the 1980 goals seemed to me then, as now, unreasonable and unnecessary. GM has been, and continues to be, optimistic that the levels of vehicular emissions specified in the new 1975 standards can be accomplished under certain conditions, with approaches under development. We have been successful in building experimental systems for vehicles which have met the 1975 emission levels, when new and at low mileage. However, GM has not yet advanced to the point of assurance that these systems, when mass produced, will equal the control performance of the experimental systems and when used in normal customer service, will meet the stringent durability and reliability requirements of the law. The consequence of this is a fact of which I am sure you are all aware. General Motors applied for a one-year extension of the 1975 standards as provided for in the Act. It was rejected until sufficient supporting information, which was then being accumulated, could be submitted. We came to the conclusion that we must request such a delay with reluctance. Let me explain how we got there.

Since enactment of the Act, we have been striving to meet the emission levels which are prescribed for 1975 and subsequent model years. You have heard of various experimental control systems which have met the required emission levels of all three pollutants on a laboratory basis. As you may know, some of these systems have been developed by GM.

In our judgment, the better systems utilize a rather complex combination of components including, particularly, a catalytic converter in the exhaust line (Figure 6). We are presently convinced

EXPERIMENTAL CATALYTIC CONVERTER

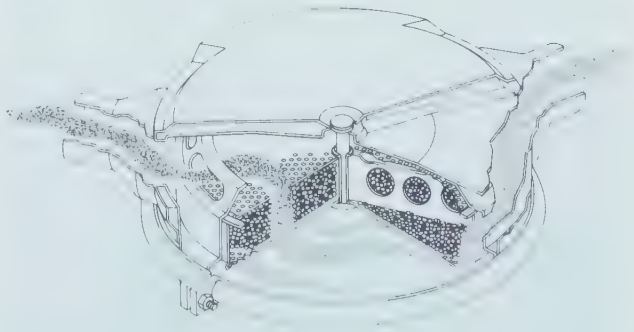


Figure 6

that this method of treating hydrocarbons and carbon monoxide is the most effective way to control these two pollutants. The National Academy of Sciences, in its report to Congress, came to the same conclusion.

Advanced Emission Control System

There are, of course, many other items besides the catalytic converter in the total package of components necessary to control emissions (Figure 7).

ADVANCED EMISSION CONTROL SYSTEM (JANUARY 1972)

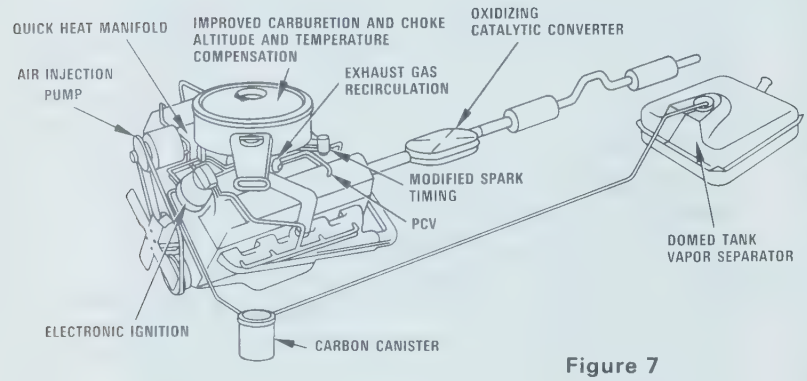


Figure 7

We must be assured of the satisfactory performance of the total system, under the varied conditions of customer service, before hardware design can be finalized for the 1975 or subsequent model years.

We must solve two large technical problems before we can translate the experimental systems into mass production hardware. Again, these are durability and reliability. By law, the systems must last for 50,000 miles or 5 years, with proper use and maintenance. We are required to provide warranty for this performance and recall the cars if a "significant number" fail to meet specified emission levels for this full period.

I will try not to bore you with technical details, but these matters of durability and reliability, for cars in the hands of the public, pose potentially serious problems. Our accelerated life tests tell us a number of things, among them that our systems will deteriorate. At present, that deterioration, in our tests and under our control, clearly shows that just barely meeting the 1975 standards at the end of the production line can only result in failure well before the end of 50,000 miles or 5 years.

Since we do not know whether or not we have a system which will meet the durability standards, we do not yet have a basis for rationally determining what maintenance recommendations should be made. We do not know the total effects of lead, phosphorous, and sulfur in the fuel. We do not yet have prescribed emission test procedures, either for the end of the production line or to determine compliance during the warranty period of 50,000 miles or 5 years. As a matter of fact, we may not be aware of all of the factors which could result in our having to recall our total production or the production of a particular make in a given model year for a "significant number" of failures. And even definition of what is meant by the term "significant number" has yet to be issued by the Environmental Protection Agency.

Some of our difficulties may be resolved by administrative determination. For example, in our request to the EPA Administrator for a one-year extension of the 1975 standards, GM pointed out many of the definitions which will have to be made by the EPA before manufacturers can be certain of reliability and durability requirements that they must meet. These are items which the National Academy of Sciences also said must be satisfactorily resolved before the prescribed levels of emissions could possibly be attained.

Unfortunately, all of the preceding matters must be resolved before we can make an evaluation on how close we could come to meeting all of the 1975 requirements.

Surely you can agree that it would be a most foolhardy step for GM to commit hundreds of millions of dollars today without full knowledge of the durability and reliability of our proposed 1975 emission system. Regrettably, we have to make some hard decisions in the near future in order to meet the requirements for tooling and commitments to outside suppliers for the necessary equipment and materials, including catalysts. These decisions are critical to our ability to manufacture 1975 model vehicles which will meet the Clean Air Act requirements.

As I said before, GM requested that the 1975 requirements be deferred a year, in order that our vehicles can be built with more driveability and reliability, and hopefully with a reduction in what looks like a sizable cost increase. The effect on the environment will be small, if a one-year delay is

granted, compared to the total improvement already achieved.

In concluding my remarks on auto emissions, I wish to assure you that this area of our business continues to be one of the highest priority concerns within GM. Our undiminished goal remains that of eliminating our automobiles as significant contributors to the air pollution problem of the nation, and we are irrevocably committed to this end.

Industrial Air and Water Pollution Control

Another of the more pressing challenges on the American scene today is the control of air and water pollution from the plants and foundries. As you know, GM is deeply involved in this kind of control program. Closely interwoven with this function is the need to evaluate energy requirements and planning, in line with the country's availability of resources.

Also, if you weave in the necessity of controlling the in-plant environment for the health and comfort of our employes, then these total functions come close to arriving at the responsibilities of our Plant and Environmental Engineering Group.

Some of the plans and progress made by this Group were discussed with you last year but since that time the Group has picked up the responsibility imposed by the Rivers and Harbors Act, and the Occupational Safety and Health Act. This new administrative burden necessitates more control, as well as the need to be continually alert to, and monitor, the changing codes and regulations. We have taken the classical definition that our environment is the aggregate of all the conditions and influences affecting life, human behavior and society, and have applied an engineering organization to control the industrial input to some of these environmental variables.

Figure 9

The Plant and Environmental Engineering Group has five broad areas of responsibilities—external environment, internal environment, power plants, energy systems, and maintenance and safety.

With this overview of that activity, I would like to detail for you a few of GM's achievements in air and water pollution control.

The dust and particulate emissions from a foundry operation in the past were so dense that the afternoon sun would be obscured. While the silhouette may have had some photographic appeal, the tons of dust did not (Figure 8). It should be noted that control devices were being used when this picture was taken. However, the wetcaps used here were not efficient enough; only about 50 percent of the dust was removed.

GM worked with suppliers on the application of high-energy scrubbers to control cupola emissions with the result that a skyline was converted to one like that shown in Figure 9. The high-energy scrub-

Figure 8

Figure 10

Figure 11

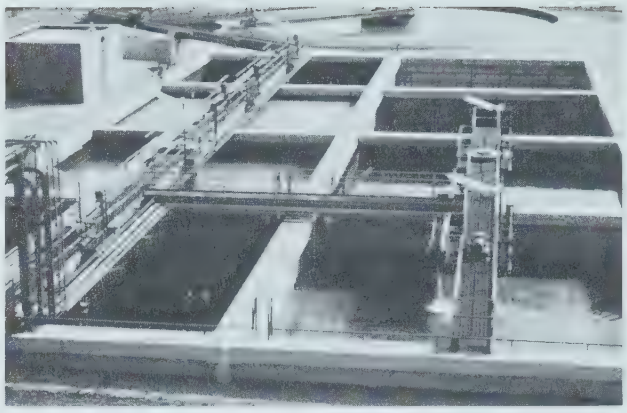


Figure 12

ber used by Chevrolet Motor Division's Nodular Iron Foundry at Saginaw, Michigan, achieves an efficiency of better than 98 percent, and all that is visible is a barely discernible plume of water vapor.

This principle also has been applied to older installations, such as the Chevrolet Grey Iron Foundry in Saginaw, with equally successful results as shown on the left side of Figure 10 (page 13). The cupola emitting smoke on the right did not have the high-energy system installed when this shot was taken. It does now.

In the water pollution control area, one of our main problems in the past was the removal of unsightly oil from the plant effluent. Chevrolet Division developed a "cooker" system to reclaim not only the oil, but some of the chemicals used to separate the oil from the water. The system shown in Figure 11 is functioning at the Chevrolet-Cleveland plant.

The concept of batch treatment is used where potentially toxic wastes such as chrome or cyanide are generated. A batch system simply means that through dual tank storage the wastes are treated, checked, and released only after we are certain they have been de-toxified. The cyanide-chrome system shown in Figure 12 is in operation at the Guide Lamp plant in Anderson, Indiana.

These are just a few of the many pollution control facilities General Motors has installed during the past 25 years. There are over 100 GM water pollution control facilities in the U.S. and Canada. And we are even more proud of hundreds of dedicated and skilled personnel that operate these facilities.

The challenges associated with industrial environmental control are complicated, but at General Motors we feel that we have identified our environmental problems, have established our objectives and priorities, and are well on our way to finding solutions.

Discussion Period

A question was asked whether General Motors was still constrained from cooperating with other automobile manufacturers in the emission control field. Mr. Starkman replied that, generally speaking, GM is not allowed to exchange information with other U.S. or foreign automobile manufacturers. He added that the industry might move forward more quickly in emission control work if such interchange were allowed. In reply to another question along the same line, Mr. Starkman indicated that General Motors was working within the law as it presently exists.

Asked if General Motors could publish the results of its findings in the emission control area,

Mr. Starkman said yes, but pointed out the difficulty of the time involved in exchanging information by publication. Most technical societies have publication lead times that vary from four months to a year, or even longer. This, of course, is a long delay before laboratory findings can be made public.

It was asked whether the emission controls substantially reduce the miles per gallon that can be achieved in operating an automobile. Mr. Starkman answered that there is a drop in fuel economy for cars equipped with emission controls as compared to non-controlled cars. He went on to say that the National Academy of Sciences Committee on Motor Vehicle Emissions estimated that there would be a reduction of from three to twelve percent in fuel economy for 1975 model cars over 1973 models. This figure should be on the order of ten percent if the kind of control systems GM envisions are placed on cars. Some control systems have been proposed which, if applied to 1975 model cars, might reduce the fuel economy by as much as 25 or 30 percent from today's cars.

Another question was whether the cost for controlling emissions from motor vehicles will become disproportionately more expensive as the levels prescribed by Federal standards are approached. Mr. Starkman said that the costs will very definitely increase. He cited figures from the report prepared by the National Academy of Sciences Committee which stated that the cost to obtain reductions to meet the Federal standards for 1973 model cars on the order of 80 percent for exhaust hydrocarbons, 69 percent for carbon monoxide, and 38 percent for oxides of nitrogen, as compared to an uncontrolled car, would be about $100 in added cost. The Committee report went on to say that to increase the control level from 80 to 97 percent for hydrocarbons and from 69 to 96 percent for carbon monoxide would cost on the order of another $200 per car. The Committee had provided no estimates of the additional costs involved for the control of oxides of nitrogen, nor did it include the additional cost of fuel due to decreased fuel economy resulting from the systems designed to meet the Federal standards. Mr. Starkman pointed out that there must be a trade-off point in the emission control picture, but it is difficult to specify precisely what it might be. He felt it is beyond where we are today but that it is far short of where we are now asked to be in 1975-1976. Mr. Starkman concluded that each successive increment of control will require a disproportionate investment by auto manufacturers and by the motoring public.

In response to a question as to whether General Motors would be able to meet the 1975 standards with a one-year extension, Mr. Starkman replied that GM believes that on the average it can meet the emission levels of the standards at the end of the assembly line, but there are many aspects of the standards, other than end of the assembly line emission levels, that are a cause of concern. For example, GM is unable to effectively develop systems to meet the 50,000 mile life requirement for the 1975 models, unless there is a better definition as to what these requirements will be. The year's extension GM has asked for will, hopefully, allow definition of these other matters and will, at the same time, allow a continuing development of the control systems so they will be more reliable.

A question then was asked when the specification for control on gasolines will be announced. Mr. Starkman answered that the announcement of lead level will hopefully be made by the EPA within the next month. (This announcement was subsequently made.) He went on to say that lead content in the fuels affects catalytic systems—the more lead, the more quickly the catalyst will deteriorate in terms of its performance in removing carbon monoxide and hydrocarbons.

Asked what effect emission control systems have on engine horsepower, Mr. Starkman said this is a matter that is difficult to put an exact figure on. He stated that systems available now, and those projected for 1975, should not significantly reduce the engine horsepower. He went on to point out that this is not taking into consideration the control equipment for oxides of nitrogen that results, basically, from making changes in an engine. Reducing the production of oxides of nitrogen in an engine is in the same direction as reducing its power output, because the oxides are produced more abundantly at higher temperatures. If an engine's operating temperature is lowered to reduce these oxides, so is its efficiency. GM is hopeful that some system can be worked out that will not cause as large a penalty as might be anticipated in controlling oxides of nitrogen.

A clarification was requested of the data in the presentation which indicated that the popular

notion of the automobile contributing 60 percent of the country's pollution in tonnage should be changed to approximately 40 percent, but that to be even more realistic a figure of about 10 percent should be used.

Mr. Starkman replied that for 1966 the Public Health Service published figures that indicated the automobile contributed 60 percent of the air pollution problem. This 60 percent figure was obtained by making an estimate of the number of pounds of hydrocarbons, carbon monoxide, oxides of nitrogen, sulfur dioxide, and particulates that came from the tailpipe of an automobile, then multiplying by the number of automobiles on the road. That figure remained until another study was made for 1968 based on the same pollutants, but including improved data. The 60 percent figure then was revised downward by the EPA to 40 percent to indicate the total tonnage in the United States of pollutants that came from the automobile. Then, a little over a year ago, two college researchers approached the subject from the standpoint of asking how much effect does one pound of carbon monoxide have on health, in terms of ambient levels; how much does one pound of sulfur dioxide, oxides of nitrogen, hydrocarbons or particulates have. They then multiplied each of the respective tonnage figures by the health effect factor and arrived at a figure of about 10 to 12 percent as the number that represents the automotive share of the health and plant effects part of the problem.

Mr. Starkman pointed out that the reason why the number changed so rapidly was because the principal pollutant, as it affects health across the country, is not carbon monoxide, but oxides of sulfur, and that the automobile is a very low contributor of this particular pollutant.

A question was asked if figures were available on the automobile's contribution to air pollution in population centers. Mr. Starkman replied that there have been a number of calculations made, or now in the process of being made, by experts in the field, but added that the automobile's contribution differs radically from one city to another.

VEHICLE SAFETY

Louis C. Lundstrom

LOUIS C. LUNDSTROM *began his career with General Motors as a test engineer at GM's Milford, Michigan, Proving Ground in 1939, shortly after receiving a B.S.M.E. and M.S. in Engineering from the University of Nebraska. In 1953 he became Assistant Director of the Proving Ground, and three years later was appointed Director.*

In 1965, Mr. Lundstrom was named Director of Automotive Safety Engineering, which then was part of the GM Engineering Staff's activities. In April 1971, Automotive Safety Engineering became part of the Environmental Activities Staff, with Mr. Lundstrom as Director. He presently directs and coordinates all automotive safety for GM and is responsible for test work at the Proving Ground affecting the future design of GM automobiles in regard to occupant safety. He also directs the GM program on safety standards and the liaison with the National Highway Traffic Safety Administration.

Mr. Lundstrom is an active member of the Society of Automotive Engineers' Research Executive Committee and the Automotive Manufacturers Association's Safety Research Committee. He has served as a member of the Engineering Advisory Board of the S.A.E., the executive committee of the Highway Research Board of the National Academy of Sciences—National Research Council, and as chairman of the Vehicle Safety Development Committee of the A.M.A. In 1962, the University of Nebraska awarded Mr. Lundstrom an honorary Doctor of Engineering degree for his work in test engineering and highway safety.

To discuss future progress in safety, it is important to realize that the safety regulatory climate has changed from what it has been in the last five years.

During the early stages of the standards setting process, GM introduced such innovations as the energy absorbing steering column, the side guard beam, contoured windshield header, the shatter resistant inside mirror, cargo-guard, steering wheel lock, improved windshield glass, and the infant carrier. We were able to do this while complying with many standards then being issued that paralleled various industry practices in key safety areas.

In 1971, however, the Safety Administration's attitude, viewpoint, direction—call it what you will—changed. They articulated this change publicly, in the very first paragraph of their Annual Report on safety to Congress, submitted August 1971, which announced a policy of exploring "new and *advanced* safety standards for motor vehicles."

The result has been that our safety development work has had to take on a different posture, either to verify whether safety performance now made mandatory by the Safety Administration is feasible, and can be met within their time frame, or to prove to them that their standards are unattainable and beyond the state of the art.

Of primary importance is our concern whether our customers will continue to realize more safety for their extra dollar as before, or whether they will be required in the future to pay for elaborate safety systems that provide little, if any, additional benefit.

Recent accident data give an encouraging picture of past efforts. They indicate that progress in safety has been taking place. Dr. B. J. Campbell, Director of North Carolina's Highway Safety Research Center, recently completed a study of accidents throughout North Carolina. His conclusion: "The same circumstances that would have produced 115 accident injuries in 1961 would produce only 66 injuries in 1970." This is a significant finding.

From another source: Estimates of the National Safety Council indicate a 4.7 fatality rate per 100 million vehicle miles traveled for 1971, the lowest ever recorded in automotive history, and a full point lower than the 5.7 fatality rate registered five years ago. If people had been killed this past year at the same rate as they were in 1966, there would have been over 11,000 additional fatalities.

To sum it all up, we have seen a definite upgrading of vehicle and highway safety. And remember, cars with improvements incorporated since 1966, such as the energy absorbing steering column, still do not make up more than half the number now on the road.

Occupant Protection Standard

But what lies in the future? To begin with, the

Figure 13

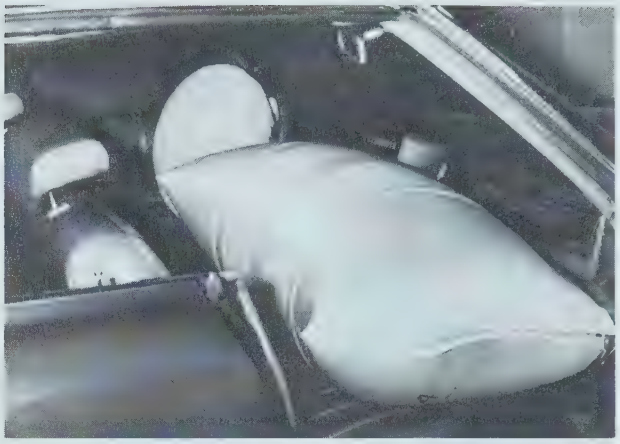


Figure 14

most significant and perhaps difficult of standards: the regulation governing occupant protection.

The first stage of this standard went into effect in January, 1972. It requires that front seat lap and shoulder belts utilize a common attaching point (Figure 13), and have a visual and audible warning system to remind people to use lap belts. Retractors also must be provided for rear lap belts. Most people, unless they've had occasion to buy a car this past month, are unaware of the front seat belt change. (At this point, a film of correct usage of the new front seat belts was shown.)

The second stage of the occupant protection standard goes into effect August 15, 1973. It has three options. We must *either*: (1) provide the same level of protection as is required in the 1976 or third stage of the standard, which will be discussed later, *or* (2) provide passive protection to front seat occupants in 30 mph frontal collision, *or* (3) use an integral lap/shoulder belt that is tied in with the starter—that is, the car cannot be started until front seat occupants have belted up.

The 1976 stage of the occupant protection standard is the source of most confusion at present. It means that within the next few years we must develop, test, and plan the production of a thoroughly reliable passive restraint system, or combination of systems, to protect all occupants in impacts equivalent to 30 mph frontal and 30 degree angular barrier impacts, as well as a 20 mph side impact. There also is a choice between 30 mph rollover protection or providing a specified roof strength.

The Air Cushion

We have every reasonable kind of system under development to meet these requirements. Under

Figure 15

Figure 16

present circumstances, the leading candidate for passive restraint usage in 1976 is the air cushion (Figure 14). It has undergone the most development, and is the most convenient for the occupants.

Since your last visit, we can report that the air cushion has undergone 34 dynamic, live volunteer tests at Holloman Air Force Base in New Mexico sponsored by the Safety Administration. Air Force volunteers, using GM designed units, were tested successfully at speeds up to 31.4 mph (22g's). (A film then was viewed showing sequences from the Holloman tests.)

Our next logical step is to remove the air cushion from this carefully controlled environment, and place it in the real world. Our projected field test of air cushion-equipped cars will be our first such attempt, beginning sometime this fall.

These cars will have front seat passive protection representative of our best efforts to date. They will have a dual system. The air cushion for front seat passengers will be separate from the driver's. This does not mean both will fire simultaneously for every accident situation. They will operate on a "dual level" principle; that is, in low severity accidents, only the passenger side air cushion will inflate (Figure 15). It is felt that at low levels, the steering wheel and column is able to protect the driver without air cushion assist. In more severe impacts, both the passenger and driver air cushions will inflate simultaneously (Figure 16). The passenger side unit then will receive a full charge rather than the minimal fill used for low severity accidents.

The field test will provide experience with air cushion production, including the establishment of reliable quality control techniques. It will enable us to test necessary diagnostic equipment in the field, as well as to establish effective repair and replacement practices.

We also hope to learn about the injury reducing potential of the air cushion under real-life conditions. The test activities at Holloman and our projected field test program are evidence that our air cushion *development* work has been successful, but on a limited basis.

On a relative level, the air cushion has shown more potential than either passive seat belt restraints or thickly padded interiors. Both concepts have been explored by GM as passive protection alternatives to the air cushion.

Figure 17

Figure 17 shows one version of a padded interior, and indicates the bolster-like shape of the instrument panel.

Figure 18 shows an example of a passive belt. It is moved out of the way automatically during entry or exit, then returned into place when the door is closed to secure the occupant.

One advantage that the air cushion has over both is convenience—it's out of sight, basically. Of more importance, it presents a much greater load distributing surface to the occupant's body than either belts or padding (Figure 19, page 20). This becomes important in higher speed impacts where, hopefully, the air cushion can come into its own.

However, our enthusiasm must be tempered with discretion. There continue to be problems, some of which are characteristic of any new product, others unique to the air cushion itself.

For example, the length of time an air cushion

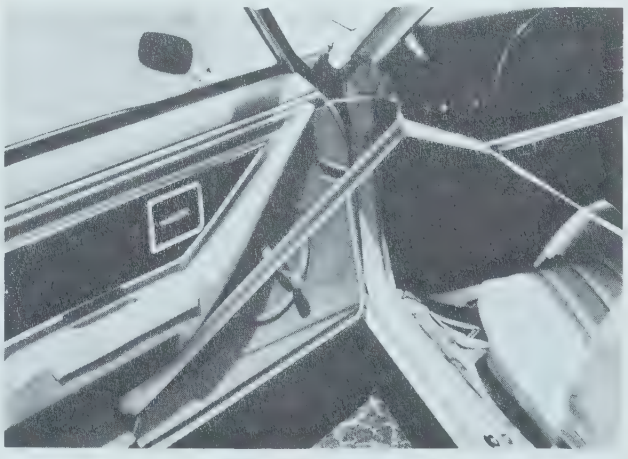


Figure 18

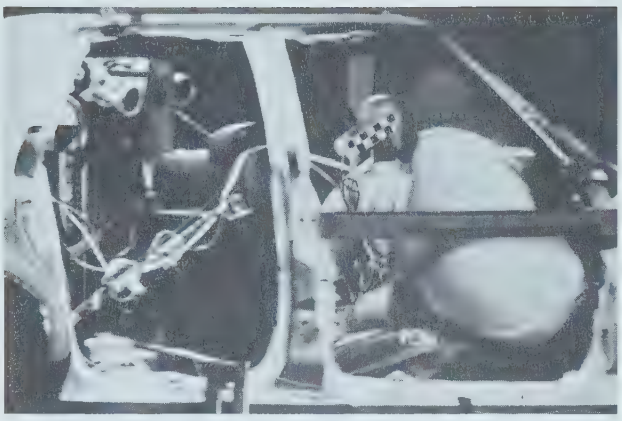


Figure 19

can remain operable in a car is purely speculative. Testing of this highly sophisticated and complex system has not been sufficient to determine its life capability. It could be two years, five or ten. Much more component testing is needed to establish such criteria, especially in the field. Our short-term tests simply have not been extensive enough to establish long range predictions of life expectancy *under* heavy usage, *under* various different climates and weather conditions, *under* long periods of being packed in a dormant state—*under* all conceivable conditions that can affect reliability and life expectancy.

This has had a significant impact upon our point of view as a manufacturer. Like various other systems within a vehicle, the air cushion represents a potential liability risk to the manufacturer, not to the vehicle driver or owner. *Unlike* more basic systems, which have been tested to a high point of reliability over many years of automotive development, the air cushion is a newcomer. In other words, it has no track record, no form on which to bet, yet *must* cross the finish line a winner in its very first race and every race thereafter, despite the jockey or the track! The government has placed full responsibility upon the manufacturer to produce that winner.

If our responsibility were extended only to the driver or front seat passengers, the risk would be reduced because the majority of our air cushion development experience lies in these two areas, especially the passenger side. By being required to provide passive protection for *all* occupants, front and rear, under *all* types of frontal as well as lateral impact situations, the risk is vastly multiplied. In fact, we do not yet have a practicable restraint system for rear seat occupants.

Nor is the risk only confined to a go-or-no-go situation. One also must consider other situations potentially hazardous to occupants, such as the effects of rebound, noise, sitting out-of-position, or even of obscured vision on the part of a driver who might be fighting to retain control of his vehicle after initial impact has taken place. These are unknowns that make the burden of risk lie heavily.

The laboratory success of the air cushion is dependent upon a dummy—an inert mass of rubber, plastic, and metal molded into the shape of a human being (Figure 20). The available test dummy has proved unreliable, unpredictable and just plain deficient. The result has not been good for test purposes.

We need a dummy that is both human-like in its responses and repeatable from test-to-test, but human tolerance data are still insufficient to design accurate dummy hardware. GM does have human tolerance and dummy development programs in progress.

Bumpers

Now for the second of our more newsworthy safety standards: Exterior Protection or, more simply, bumpers.

Briefly, our 1973 models must have bumpers providing 5 mph barrier impact protection *of safety elements* at the front and 2.5 mph protection at the rear.

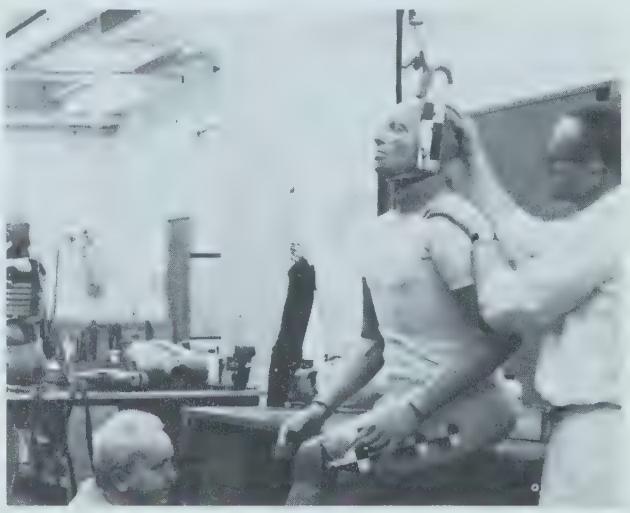


Figure 20

For 1974, *rear* impact protection must be raised to 5 mph, and both front and rear bumpers tested by pendulum impacts at different heights along each bumper face. This is intended to provide bumper match between vehicles.

There also are six bumper laws for 1973 or later passed by individual states. Many other states are considering them. They are directed not at safety but vehicle damage, and if carried too far could have an adverse effect on occupant injury.

Unless the courts decide that existing Federal safety standards preempt state regulations, higher cost bumpers could be required in states that have stricter bumper regulations. The U.S. Senate and House both have drafted bumper bills, also directed to property damage, not safety.

Many of you may recall the bumper demonstrations arranged for your viewing last year. The bumper systems you saw then represent the kind that will be appearing on the front of regular and intermediate size cars in 1973.

Bumpers and occupant protection are not the only standards in effect for the next few years. For 1973, there are also new standards on the illumination of driver controls, brake hoses, side door strength, flammability and vehicle loading.

Other Facets of Highway Safety

Current emphasis on the safety of the vehicle has led us to question whether other facets of the highway safety problem, especially off-road safety and driver capability, are being over-shadowed.

For the past 14 years General Motors has made its roadside development work at the Proving Ground an open book. Only recently have we begun to see growing public use of GM's pioneering development work toward safer bridge parapets, flatter roadsides, breakaway lamp posts, better guardrails, and other improvements for roadside safety (Figure 21).

The potential for lives saved through safer roadsides could be very significant, yet far too little is being done. Robert Hess, Director of the University of Michigan's Highway Safety Research Institute, recently told the Ad Hoc Committee of Science and Technology of the Executive Office of the President that, for the next several years, no less than 10 percent of Federal and state road funds should be used to correct roadside hazards and to carry out purely safety-oriented road projects.

Figure 21

Since 1967, Federal funding of 634 approved driver education projects has amounted to more than $37 million. This seems like a large amount. However, during the same period, General Motors alone paid $49.5 million in allowances to dealers who loaned out cars and trucks for driver education purposes.

Moreover, GM has conducted very promising exploratory work in emergency car handling techniques (Figure 22). Last November, for example, the Proving Ground reported that 30 Oakland County, Michigan deputies, who had received emergency car handling training at the Proving Ground in 1969, had had only five accidents over the past two years, with no injuries or lost time. Another control group of 30 deputies, who had not received this training, had had 10 accidents, two injuries, 87 lost days, and eight times greater damage costs.

Figure 22

Significant? This sample could be, even though it's small. The role of the driver in accident causation or avoidance has never been properly assessed, and does deserve more study.

As a matter of fact, the GM Proving Ground advanced driver training group constantly is being summoned to different states to conduct instructional classes for state safety center teams. These teams are in the process of being formed to fulfill highway standards and require professional help not available from the Safety Administration.

No consideration of driver effect upon highway safety can fail to take the drinking driver into account. He reputedly is responsible for half our fatalities. The General Motors drinking driver inhibitor, the Phystester (Figure 23), is an expression of our interest in this area. The Safety Administration has requested 50 of our units for evaluation, and we are building another 150 units for our own field testing purposes. A primary objective will be to sample public reaction to this innovation under actual field conditions.

There is no guarantee that results of these field tests will be favorable or that the Phystester will become publicly accepted. Nevertheless, it represents a positive effort to attack a major facet of the highway safety problem which, if solved, would have a greater impact upon fatality reduction than any other measure.

Figure 23

From a cost effectiveness standpoint, it may be cheaper to stop the drinking drivers from driving, rather than provide them with all-out protection from their driving errors.

Now that I have described our past and current progress in vehicle safety, as well as some of our problems, I do want to add that at no time do we feel pessimistic about our work. We are very optimistic of the future, and we will continue to provide GM customers with the highest practicable levels of safety that time and technology will allow.

Discussion Period

A question was asked if General Motors was cooperating with the Safety Administration in developing stricter standards in certain areas, such as braking and lighting. Mr. Lundstrom replied that frequent meetings are held with the Safety Administration to exchange information on these and other subject areas. He pointed out that there is presently a major problem that stems from the Safety Administration's proposal to reduce stopping distances for trucks to a degree industry is unable to achieve. In this case, Mr. Lundstrom said, the Safety Administration has gone beyond what GM believes to be the state of the art. There definitely is an exchange of information on this particular subject. In regard to lighting, Mr. Lundstrom said that for many years the auto industry has provided an open book on possible changes. Because lighting systems influence all vehicles on the road and must be compatible with each other, it is important that close liaison be maintained not only with the Federal government, but also with the states.

Asked if tires are a matter of any significance in safety, Mr. Lundstrom said that they are very important. They assist in acceleration, cornering, braking, and handling. He pointed out that tire effect can be lost, however, when road surface is poor. If a road becomes slippery, for example, there is little a tire can do to overcome the poor road surface. It is a combination of good road surface and a good tire that provides safety.

In response to a question asking for an estimate of the cost that a consumer will have to pay for various safety features in four or five years, Mr. Lundstrom said that he could not give a breakdown on cost because some of the safety items have not been developed to a point where a cost figure could be very accurate. He indicated that some people have made such estimates which have been published, but these had to be considered strictly as estimates. He said that it appears, however, increases probably would be substantial.

A question was asked if 30 mile per hour barrier crashes represented the speed up to which the greatest number of injuries occur. Mr. Lundstrom indicated that this speed is roughly equivalent to hitting a parked car of equal size at 60 miles per hour. A fixed barrier impact is the most severe of impact tests, and is the standard that engineers are using today. He went on to say that the 30 mph (barrier equivalent) level is typical of a large portion of highway accidents. An improvement in safety protection in the general area of a 30 mph impact will have a significant reduction on the number of fatalities and injuries on the highway today. Mr. Lundstrom also indicated that such test impact severities are minimum Federal standards. Every vehicle produced must be at least that good. Automobile manufacturers, to meet those minimum requirements, must have designs capable of going beyond that point. Mr. Lundstrom concluded that he was confident that improvements in safety will have a marked effect on highway accident statistics.

One person asked if General Motors was hesitant in placing additional safety devices on cars because the additional cost for these items would have to be passed on to the consumer. Mr. Lundstrom replied that GM does not hesitate to provide additional safety features if its studies show that there will be a real benefit to the consumer. The same person then asked what particular items GM would not consider putting on its cars because studies indicate they would be of small benefit to the consumer. Mr. Lundstrom answered that some now being proposed as Federal standards could serve as examples. He first commented by saying that when a standard is issued, the auto manufacturer has no choice—he must do it. Therefore, any objections must be voiced before the standard comes into effect. Mr. Lundstrom then proceeded to the example of a proposed standard for periscopes to provide better rear vision. He indicated that such periscopes would be quite expensive, and that GM is unable, at this time, to measure the safety benefit that one would receive from such an expensive installation. To meet the angles proposed by the Safety Administration, some of these devices would put a high mirror across the entire width of the roof. The car structure also would be weakened by the necessity of having an opening through the roof to the inside of the car. Mr. Lundstrom pointed out that the proposed standard on rear vision is an example of one area in which GM is able to work with the government because the periscope concept has not as yet been issued as a final standard. He concluded that GM would be hesitant to encourage such a device as the periscope because it does not seem to have a measurable or predictable safety/cost benefit.

Another individual asked why disc brakes are not standard equipment, if they are good enough to deserve extra cost and offer an added feature. Mr. Lundstrom replied that disc brakes are standard in the front on all full size GM cars, and on the Camaro, Firebird, and Vega, and are standard on the front and rear on Corvettes. He further added that the standard drum brakes are quite adequate for most conditions. For those situations where a brake with a greater capacity is needed, and disc brakes are not standard, they are available as an extra cost option.

In regard to a question on what GM is doing in the way of safety features for other vehicles—buses, for example—Mr. Lundstrom said that new buses are being proposed that will provide not only greater convenience for passengers, but improved occupant protection as well. Although buses are one of the safest modes of transportation in the world today, more safety improvements will be offered. One example he specifically cited was work being done to determine how to keep windows intact in an accident, yet have them easily

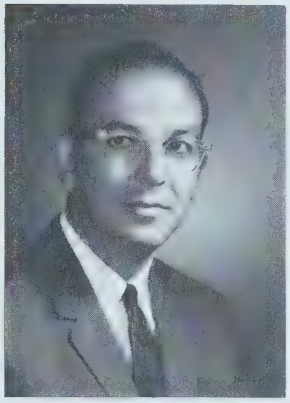
removable for fast exit. Roof exits will also be available because if a bus does tip over on its side, people not tall enough to crawl out of windows can use roof exits. Mr. Lundstrom stated that belts for buses are questionable, but perhaps improvements can be made in better seats and better padding. Much depends, however, on what the buyer desires to have in his bus transportation package. Since much of the bus business is on customer order, it is up to the manufacturer to convince the customer to purchase safety improvements where needed.

A question was asked if the air cushion will work if a passenger car is struck in the rear, or if it will work only in the event of a front end collision. Mr. Lundstrom answered that the air cushion, as it is presently being developed, will not help on rear end accidents.

VEHICLE POWER SOURCES

Dr. William G. Agnew

DR. WILLIAM G. AGNEW *joined the GM Research Laboratories in 1952, shortly after receiving a Ph. D. degree in mechanical engineering from Purdue University, which also granted him a B. S. M. E. and M. S. M.E. degree. His early work at the Research Laboratories was with the Fuels and Lubricants Department, and he became head of that Department in 1967. When the Emissions Research Department was formed in 1970, Dr. Agnew was appointed Department head. In 1971 he was named to his present position—Technical Director of Engineering Research—and given jurisdiction over the activities of the Gas Turbine, Emissions, Vehicle, Mechanical, and Special Programs Research Departments.*



Dr. Agnew's work at the Research Laboratories has centered on research studies dealing with various aspects of spark-ignition and gas turbine engine performance. For his work on end-gas temperature measurements in spark-ignition engines, Dr. Agnew received the Society of Automotive Engineers' Horning Memorial Award and Medal in 1960.

Dr. Agnew has authored or co-authored more than a dozen published papers on the subjects of his research. He is a member of a number of technical and scientific societies and has served as a director of the Combustion Institute since 1960.

General Motors' investigation of power sources for automotive vehicles has been carried on continuously since the very beginning of the Corporation. Since the identification of the automotive emission problem some 20 years ago, the investigation has intensified greatly.

The new air pollution criteria bring many new powerplants into competition and require a new look at some of the older concepts. Some people ask us: If there is such difficulty in making the spark-ignition, gasoline engine meet the emission requirements of 1975 and 1976, why doesn't GM put an entirely different powerplant into production immediately which will meet these requirements? We do not believe that there is now any practical alternate powerplant which will meet the requirements of 1975 and 1976 better than this engine.

It is our belief that the spark-ignition, gasoline engine will be the automotive powerplant for this decade. There are two reasons for this belief. First, we see no way that any radically different powerplant could proceed through the long process of research, design, development, component testing, proving ground testing, production tooling, field trials, and eventual volume production in this short time period. We are, in fact, at the point right now where research and development of our 1975 model car powerplants must be essentially complete if we are to mass produce the cars demanded by the American public in 1975. Secondly, it appears to us that the spark-ignition, gasoline engine with the emission controls which we are now developing in our laboratories will be entirely adequate to remove the automobile as a significant contributor to air pollution for this decade.

Beyond this decade, some people worry that automotive air pollution will rise again to serious proportions as car population continues to increase. We believe this is not a serious threat. Today, automotive air pollution is a problem only in our most congested metropolitan areas. In these particularly high vehicle density areas, the car population does not increase with time because these areas are and have been saturated with cars for many years. Thus, a 95 percent effective emission control produces about a 95 percent reduction in emissions from the cars in these congested areas.

The conclusion, then, is that regardless of increasing overall car population in the United States, the automotive air pollution problem will never again reach the peak values of recent years in the worst locations, and these worst instances will, in fact, become and remain considerably improved.

In addition, we should be able to improve even further on this situation in these dense metropolitan areas by greatly reducing congestion below its present level. Given sufficient time, we envision a considerably different transportation system for the dense metropolitan areas. We expect to see a balanced mix of mass transportation and private

vehicles. This system should be vastly superior to that which we have today in efficiency, in effectiveness, and in convenience. We expect, however, that it will require a much wider variety of vehicle types than are currently in existence. This wide variety of vehicles, in turn, will require a wide variety of power sources.

Alternate Powerplants

In the research and engineering laboratories of General Motors, we feel it is our obligation to make available this wide variety of powerplants to power the various pieces of our future transportation system. It is, of course, axiomatic that all of these power sources of the future must have low emissions. At the same time, each powerplant must meet all the other functional transportation requirements including efficiency, low cost, convenience, and customer acceptance. Each proposed powerplant must compete with all the others for a place in the transportation system.

Figure 24 lists the powerplants which have received extensive experimental consideration in our laboratories. At the top of the list, of course, is the spark-ignition, gasoline engine. Its feasibility cannot be denied, and it will remain a strong contender in the automotive power source competition of the future. Also indicated are a few of the more radical modifications of this powerplant which could find a place in our transportation system if current research and development prove successful.

ALTERNATE POWERPLANTS FOR THE FUTURE

1. Radically Modified Spark-Ignition Gasoline Engines
   a. Rotary Combustion Engine
   b. Stratified-Charge Engine
   c. Intake Valve Throttled Engine
2. Diesel Engine
3. Gas Turbine
4. Battery and Fuel Cell
5. Hybrid Engine-Electric
   (Combining the Gasoline Engine, Stirling, or Gas Turbine w/Electric)
6. Stirling
7. Steam

Figure 24

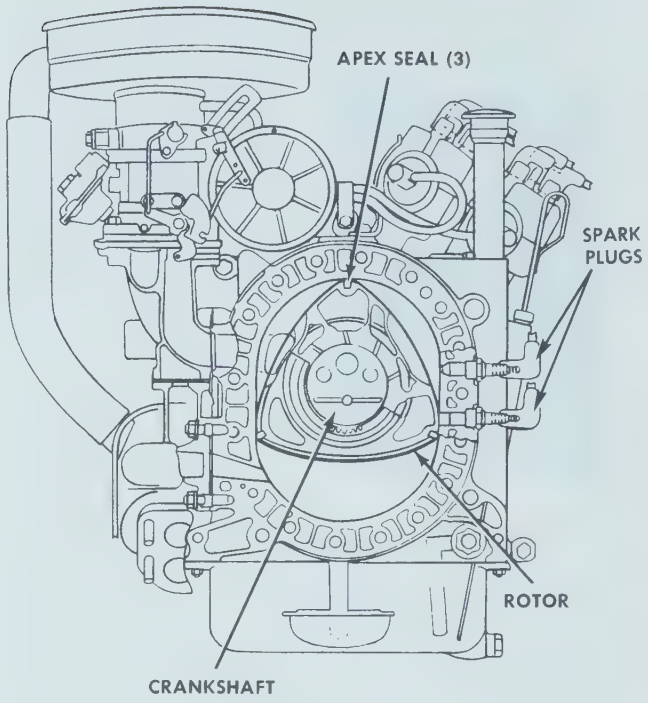


Figure 25

Rotary Combustion Engine

The rotary combustion engine (Figure 25), or the Wankel engine, is in fact not much different in concept from our current piston engine. It is different in the mechanical arrangement of its "pistons" and combustion chamber. The engine's input of fuel and air, its power and efficiency, and its exhaust emission problems, however, are not greatly different from those of our present engines.

Because of the rotary combustion engine's different mechanical configuration, it gives rise to a variety of different mechanical problems. These problems, principally the sealing between the rotor and its housing, have been the subject of extensive research and development in the past two years. Success in this effort will produce a very attractive powerplant for passenger car use.

In its undeveloped state with inadequate rotor sealing, the rotary combustion engine has discouragingly high emission levels. However, with experimental engines in which the sealing problem is corrected, emissions again turn out to be very similar to those of a corresponding piston engine. The rotary combustion engine is then subject to the same control means presently being developed for piston engines.

Stratified-Charge Engine

The stratified-charge engine concept is a very old one. Numerous investigators over the years have tried to make this engine function satisfactorily with limited success. The engine has some difficulty in operating properly over the extremely broad range of speeds and loads required for automotive application. Very precise and complicated fuel injection systems are required, along with carefully tuned fuel control elements.

General Motors has carried out a number of experimental investigations on the stratified-charge engine since the early 1940's. At present, we have four active programs on both open-chamber and prechamber stratified-charge engines. Figure 26 illustrates one of our prechamber designs now being studied.

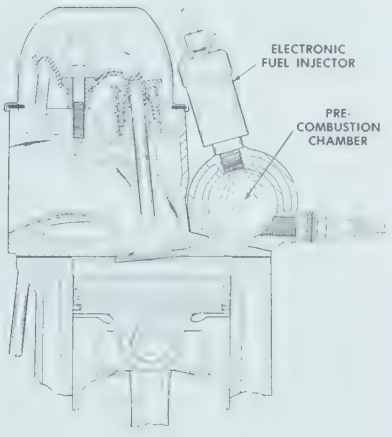


Figure 26

In practice, the carbon monoxide emissions of stratified-charge engines are usually quite low. In some circumstances, however, the hydrocarbons and nitrogen oxides may be quite high. Some tests on low mileage engines have indicated a low level of emissions, but whether this will persist for the required 50,000 miles is yet to be established.

We see serious development problems in carrying this engine concept, with its required precision tuning, from the laboratory to a volume-production prototype. Nevertheless, our research continues actively.

Intake Valve Throttled Engine

The intake valve throttled engine, or the IVT engine, has also been investigated in our laboratory for some years.

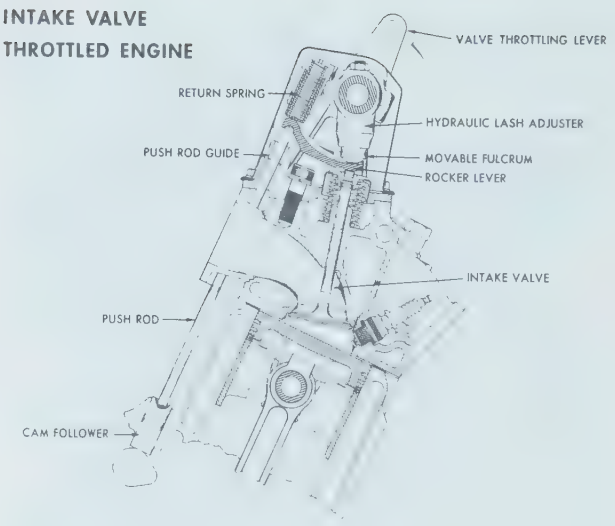


Figure 27

Figure 27 shows a cross section of this engine, and illustrates the mechanism which varies the intake valve lift as engine load is changed. This engine has no throttle valve in the intake manifold. Instead, the amount of charge entering the cylinder is controlled by varying the size of the intake valve opening. This means that extremely lean fuel-air mixtures can be burned smoothly and stably under a very broad range of operating conditions.

Smooth combustion at these very lean mixtures results in extremely low hydrocarbon and carbon monoxide emissions and somewhat reduced nitrogen oxide emissions. Good fuel economy is maintained, but exhaust treatment emission control systems are still required in order to reach 1975 emission levels. Also, nitrogen oxides have not yet been reduced to 1976 levels by any means. Again, our research continues.

Diesel Engine

As with the spark-ignition, gasoline engine, there can be no question that the Diesel engine (Figure 28, page 28) is a feasible, commercial powerplant. Most of its automotive application, of course, is in commercial trucks and buses.

With its present proportion of the automotive transportation system, the Diesel engine has not been a serious contributor to over-all air pollution. On the other hand, its smoke and odor characteristics have offended many people in local situations. The engine has, thus, been subjected to considerable research and development in an attempt to

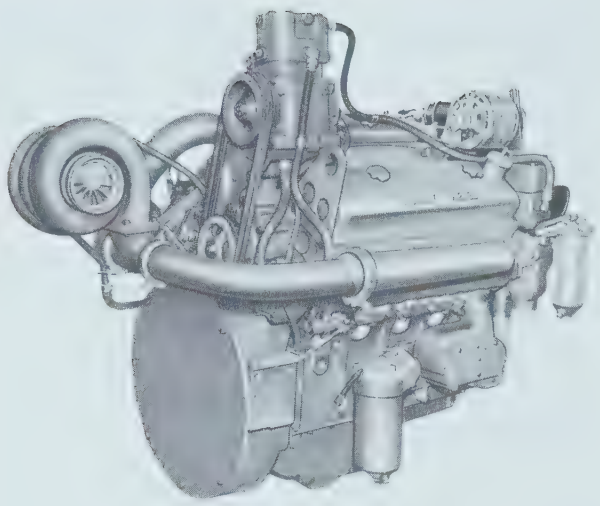


Figure 28

reduce these nuisance factors. As a result, commercial Diesel engines now leaving our factories have substantially reduced smoke and odor emissions.

As with passenger cars, emission standards for hydrocarbons, carbon monoxide, and nitrogen oxides are now coming into existence for Diesel engines in heavy duty applications. With careful design, the Diesel engine would appear to have no serious problem in meeting those hydrocarbon and carbon monoxide requirements, but the control of nitrogen oxides to the levels required may well involve some fuel economy penalties. At this point our engineers are exerting every effort to keep those penalties to an absolute minimum.

The question remains as to whether the Diesel engine can seriously compete in the passenger car field. In fact, the 1976 Federal emission standard for nitrogen oxides in passenger cars is many times more stringent than the proposed, heavy duty standards for trucks and buses. We do not know whether the Diesel engine can be made to reach the passenger car standard, and if so what compromises in the engine's other qualities will result.

For passenger car use, the Diesel suffers the additional disadvantages of increased weight, increased initial cost, increased noise, and the possible reemergence of smoke (particulate) and odor emission problems if large numbers of these vehicles were to populate our city streets. Thus, we see the Diesel engine as playing a role in future transportation systems, but perhaps not a major role in private passenger cars.

Gas Turbine Engine

The gas turbine engine is another powerplant which has been under study at General Motors for a great many years. We have been in the aircraft gas turbine field through our Detroit Diesel Allison Division since World War II. The Firebird III (Figure 29), introduced by General Motors in 1953, was an early venture in the automotive gas turbine field. We learned a great deal about gas turbine engines from this and other models in our Firebird series. Our conclusion, however, was that gas turbines could not compete with spark-ignition, gasoline engines and Diesel engines on purely economic grounds at that time. But that was in the days before emissions were of such great concern. The gas turbine is now a very live possibility.

Many people have the false impression that the gas turbine engine is pollution-free. It is true that the hydrocarbon and carbon monoxide emissions from current gas turbines are quite low, and in the range of the 1975 Federal emissions standards for passenger cars. However, nitrogen oxide emissions from conventional gas turbine combustors are several times higher than the permissible emission levels for passenger cars in 1976. We are carrying forth an extensive research effort in General Motors to devise combustors and combustion processes which will give lower nitrogen oxide emissions and, at the same time, not compromise the good hydrocarbon and carbon monoxide emission characteristics existing now. The problem is not easy, but we are making considerable progress. We are optimistic that the emissions from this engine can be made acceptable with time.

As you know, the gas turbine engine is making its first moves in the direction of commercial, heavy duty applications. There are several reasons for this.

First, a gas turbine engine's tendency for poor light load fuel economy is not such a serious detriment in heavy-duty applications. Neither is its inherently poor acceleration characteristic.

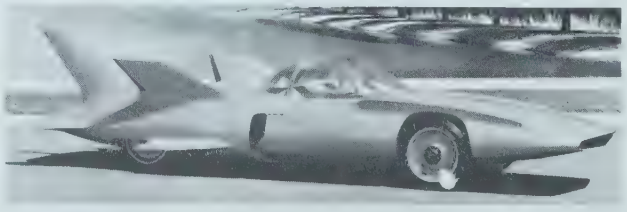


Figure 29

Figure 30

In the heavy-duty commercial market, initial engine cost, which tends to be high with a gas turbine, is not as crucial as it is in the high volume passenger car market.

Figure 30 shows a GT-309 experimental gas turbine installation under test in a large truck. Our RTX experimental bus (Figure 31) also is powered by a gas turbine engine. Figure 32 shows our Detroit Diesel Allison Division's 404 gas turbine engine which is now very close to commercial volume production. This engine is expected to meet the 1975 California heavy-duty emission standards with no difficulty. It is a 325-horsepower engine which is expected to compete economically with corresponding Diesel engines.

It is obvious that we expect the gas turbine engine to play at least this role in our future transportation system, and in this case we are referring to a not very distant future.

With respect to passenger car applications of gas turbine engines, we are not as far along. In increasing order of importance, the principal problems are acceleration characteristics, fuel economy, cost, and most crucial of all, emissions. Research is proceeding actively in all of these areas.

Figure 31

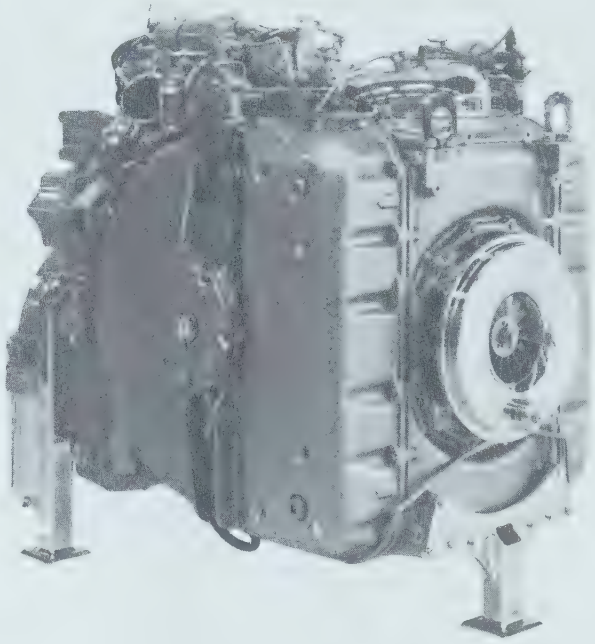


Figure 32

At this very moment, we are attempting to put together in a laboratory test vehicle many of our present advancements in passenger car gas turbine technology. Figure 33 shows the General Motors GT-225 passenger car gas turbine engine which we are now installing in a modified, production Chevrolet. We consider this vehicle to be a research test bed—a place to try out many of our new re-

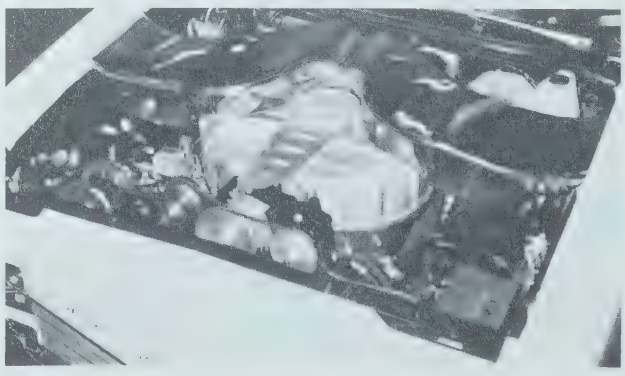


Figure 33

search schemes aimed at lower emissions, better fuel economy, faster acceleration, and lower cost. The vehicle and its engine are currently being tested. As soon as results are available we intend to report them to the technical community.

Battery Electric Powerplants

In the case of electric cars, General Motors again has actually built experimental vehicles in order to learn the problems and to develop some of the solutions for these concepts. Figure 34 shows GM's Electrovair II passenger car which was introduced in 1966. This vehicle was powered by 286 silver-zinc batteries. They gave performance similar to

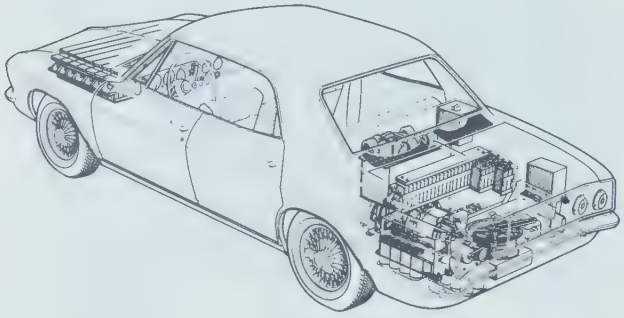


Figure 34

that of the standard production Corvair, except that the Electrovair's range was limited to 40 to 80 miles between recharges.

Figure 35 shows GM's 512 Series Electric Vehicle, an experimental, two-passenger, special-purpose vehicle intended for limited urban trans-

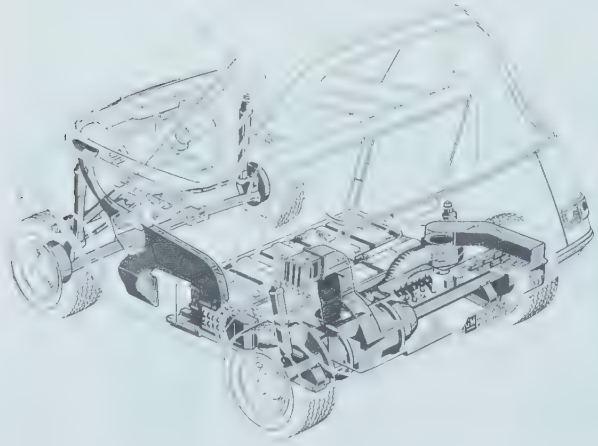


Figure 35

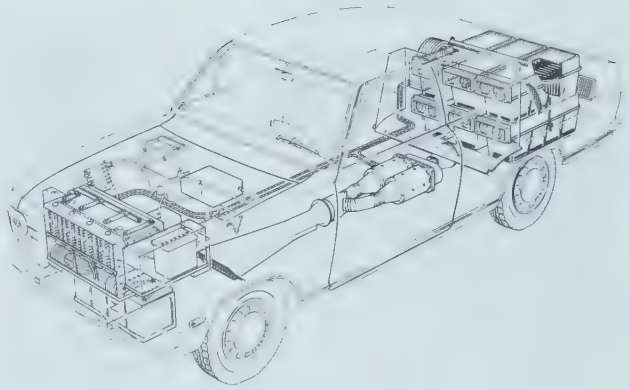


Figure 36

portation. This vehicle is powered with an 84-volt power battery pack made up of special Delco-Remy lightweight lead-acid batteries. This car has a range of 58 miles at 25 miles per hour, and can accelerate from zero to 30 miles per hour in 12 seconds.

A more recent battery driven passenger car is the XEP-1A (Figure 36). Since it is extremely difficult to get both high power density and high energy density in the same cell, the XEP-1A includes two sets of batteries. There are zinc-air batteries in the rear for high storage of energy, and, therefore, adequate range for the vehicle. Standard lead-acid batteries are in the front for high power and adequate vehicle performance. The zinc-air batteries in this car are rechargeable only by replacing all of the 300 zinc plates after each 150 miles or so of travel. The projected cost of such a dual battery system is completely beyond the range of most current passenger car customers.

Fuel Cells

Fuel cells eliminate the need for recharging batteries from a central electric power station since the fuel cell consumes fuel on-board the vehicle and generates its own supply of electric current.

Figure 37 shows the GM Electrovan, powered by a hydrogen-oxygen fuel cell. It was introduced in 1966. Aside from the problems of cost and fuel availability, this vehicle introduced safety problems associated with the hazards of hydrogen and oxygen, and the 45 gallons of potassium hydroxide electrolyte carried on board.

General Motors is continuing its laboratory studies of both batteries and fuel cells, looking particularly for breakthroughs in catalysts and electrode technology. We feel that electric vehicles

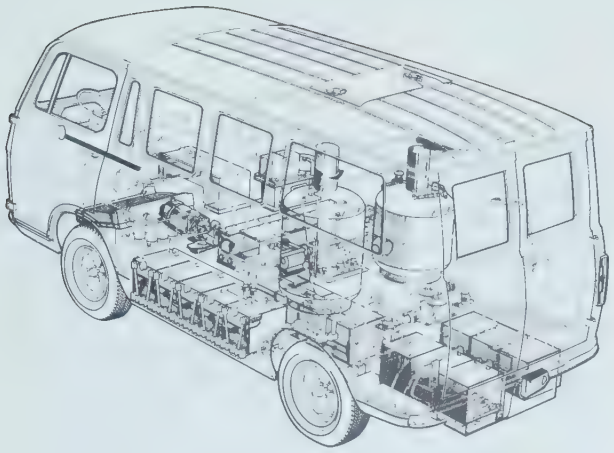


Figure 37

will have a role to play in some portion of our future transportation system.

Stirling Engine

The Stirling engine is an interesting powerplant in its own right, and could be considered an alternate engine to power an automobile by itself. General Motors has been investigating Stirling engines since 1957. Figure 38 is a cross-sectional view of a single-cylinder Stirling engine and shows the rather complex mechanism. This engine has extremely low hydrocarbon and carbon monoxide emissions. The nitrogen oxide emissions, however, require additional control measures. The engine tends to be heavy, complex, and expensive. General Motors has now completed its evaluation of the Stirling engine, and it does not appear suitable as a prime mover for passenger car use.

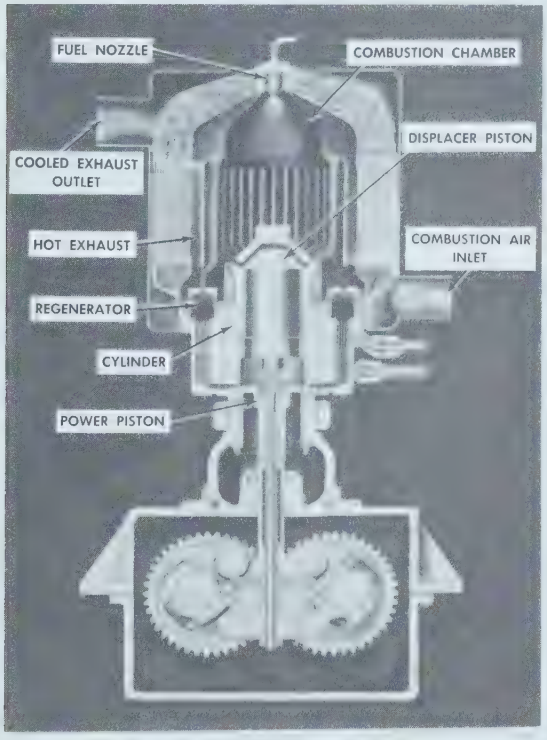


Figure 38

Hybrids

The so-called Hybrid Engine-Electric Vehicle offers another approach to an electrically-driven vehicle which does not require the drawing of electric power from a central electric generating station. The vehicle utilizes a small, fossil fuel powered engine to charge batteries. These batteries are connected to electric motors which assist in driving the vehicle's wheels. The heat engine could be either a gasoline engine, a Stirling engine, or a gas turbine engine. We have, in fact, examined all three possibilities at General Motors, and have built examples of the first two.

Figure 39 shows GM's 512 Hybrid Gasoline-Electric Vehicle from the same series of special-purpose urban cars discussed earlier in the pure

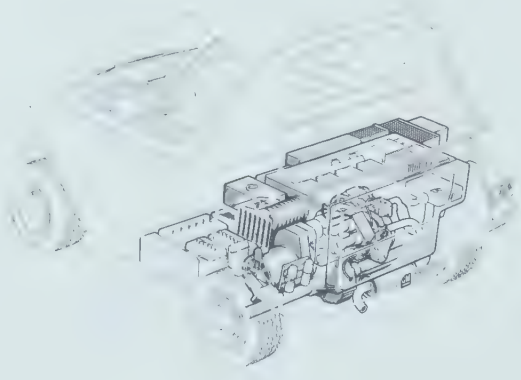


Figure 39

electric version. This power system consists of a small gasoline engine, coupled with a DC series electric motor, through an electro-magnetic clutch.

Figure 40 (page 32) shows a Stirling-Electric Hybrid car, the GM Stir-Lec II. The Stir-Lec series of vehicles was introduced in 1968. In this vehicle an 8-horsepower, single-cylinder Stirling cycle heat engine runs at constant speed and drives an alternator to charge a lead-acid battery pack of 14 batteries in series. A 20-horsepower DC motor drives the vehicle.

In general, the over-all advantage of a hybrid concept is that the battery serves as a sort of power ballast, relieving the engine of the requirement to respond to very rapid transient demands. Thus, the engine can operate more nearly at its optimum

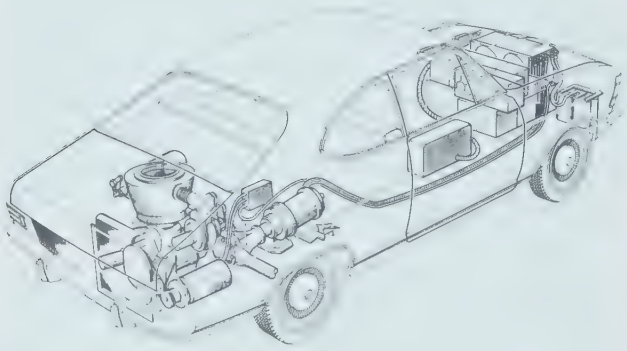


Figure 40

condition for low emissions. On the other hand, the over-all system tends to introduce some serious efficiency losses in the repeated rapid conversion of energy from mechanical to electric and back to mechanical form. We are presently trying to maximize the benefits of this power system to determine whether we can make this a useful vehicle concept for some applications.

Steam Engine

The last of the alternate powerplants listed in Figure 24 is the Steam Engine, or Rankine Cycle Engine. General Motors has conducted investigations of this type of powerplant intermittently since about 1930. There has been a great deal of publicity in recent years throughout the United States concerning the application of steam engines to automobiles. General Motors has constructed two such steam-powered vehicles and demonstrated them to the public.

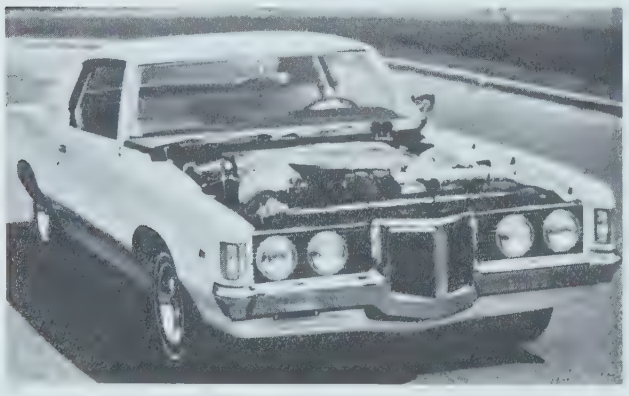


Figure 41

Figure 41 shows the SE-101, steam-powered Pontiac Grand Prix, which was designed and built in the General Motors Research Laboratories. It is the world's first steam car with complete power accessories. Starting functions for this car are completely automatic. The operator turns the key, waits 30 to 45 seconds, and when a light signals adequate steam pressure, he drives away.

Figure 42

Figure 42 shows GM's SE-124 Steam car, which includes a powerplant designed and installed in a modified Chevelle for General Motors by Besler Developments, Inc., a California engineering firm with more than four decades of steam engine experience. The SE-124 powerplant is not as sophisticated as the SE-101, nor does it drive the many accessories of the SE-101. Thus, in this smaller vehicle its fuel economy is somewhat better.

Problems with these experimental steam cars are much the same as for any steam-powered automobile at today's state of the art. One problem is fuel consumption (the SE-101 gives 3.8 mpg in urban driving). Another problem is the size and weight (the SE-101 weighs 450 lbs more than the engine it replaced—at less than half the horse-

power). A third problem is water consumption (the SE-124 obtained only 10 mpg of water on an 80°F day and on a level road, at 40 mph). Complexity, cost, water freezing, and lubrication are additional problems, and, most discouraging of all, the steam engine does not prove to be a low emission engine.

In view of the steam engine's inadequate emissions performance, combined with its other disadvantages, General Motors is not optimistic regarding this type of powerplant for passenger car use. However, it may yet find some application in our transportation system. We are continuing to watch closely for any development which may occur in steam engine technology which might change the picture.

Summary

These, then, are the powerplants which have received GM's main interest to date as possibilities for future transportation systems. All these power sources have serious development problems. But these are the kinds of technical challenges on which GM engineers and scientists thrive. The competition ahead promises to be lively, and there is the possibility of many winners.

There may be small, downtown, short-trip vehicles for errands, shopping, school transportation, and similar trips. There may be hybrid vehicles for commuting, perhaps joining with a mass transportation system for some part of the trip. There may be gas turbine vehicles for heavy-duty truck operation and inter-city passenger car use. The spark-ignition, gasoline engine may still carry the bulk of non-inner-city private vehicle operation. Diesel engines may carry medium duty commercial operations, and steam engines will continue to power traffic on our lakes and rivers. And who knows what new powerplants presently unconceived may enter the picture and challenge any or all of these existing powerplants by doing a better over-all job at less over-all cost.

Discussion Period

A question was asked what percentage reductions in emissions might be expected from a 1980 spark-ignition, gasoline engine and whether the cost for such a system should be borne by the consumer. Dr. Agnew replied that, at present, General Motors does not have emission control system designs that go beyond 1975-76 levels for spark-ignition, gasoline engines. He said that some low emission concepts (such as discussed in the presentation) are being studied for spark-ignition engines, but that these are all in a research state and it is not possible to put a cost figure on them. As to whether these costs should be borne by the public, Dr. Agnew stated that it has to be recognized that eventually, costs for controlling the environment necessarily revert one way or another back to the American public.

In response to a question on whether or not GM was projecting any more emission control systems beyond the 1975 standards, Dr. Agnew said that the low emission concepts for spark-ignition engines, as discussed in the presentation, are being pursued as well as the possibility of other engines, but that the problems associated with meeting the 1975-1976 standards required that our major efforts on the spark-ignition engine be aimed at that date.

Responding to a question about fuels for spark-ignition engines, Dr. Agnew said that the fuel situation is one that has been worked on for many years. The auto industry and the petroleum industry have worked together to try to optimize the fuel-engine relationship to obtain the best overall performance, and that this work continues. In regard to gaseous fuels, such as liquid petroleum gas and liquified natural gas, Dr. Agnew stated that GM has studied such fuel systems for spark-ignition engines and tested them in vehicles. Their emissions, however, are not acceptable as far as the 1975-1976 standards are concerned, although they do provide considerable improvements over the 1972 version of the spark-ignition engine. Dr. Agnew indicated that the big problem with the

introduction of gaseous fuels for spark-ignition engines would be one of fuel availability and distribution to large numbers of users. Dr. Agnew went on to say that GM is always looking at changes that could be made in current gasolines to see what kind of gains could be made with present spark-ignition, gasoline engines. There are some changes that could be made in gasolines which would assist in the emissions area (such as removal of lead, sulfur, and phosphorus, and changes in volatility), and contact is being maintained with the petroleum industry to study further these changes. Dr. Agnew concluded that the major question is what kind of benefits can be obtained from fuel changes, and what would be the cost to the American public for these changes. There is a matter of trade-off and an optimum would have to be considered. GM is seeking to establish what that optimum might be by further discussions with individual petroleum companies.

Asked about our fossil fuel reserves for the future, Dr. Agnew replied that there is great concern over depletion of fossil fuel reserves. Since General Motors is involved in the energy conversion business, research people are trying to find the most efficient ways to convert fossil fuel energy into useful outputs, and the entire energy picture is being studied. A matter which disturbs us is the willingness of some people to throw away our present fuel economy in favor of environmental control, with no consideration of what that means in terms of energy resources. GM does not believe that the loss of 20 percent in fuel economy is an insignificant thing. At the same time, when looking at various future power systems, efficiency of operation must be kept in mind. This is not simply a matter of cost to the consumer, although this is an important consideration; it also is a consideration in the conservation of natural resources—both for the United States and the rest of the world. Dr. Agnew went on to say that there is a lot of thinking going on regarding fuel resources and pointed out that there are technically feasible ways to obtain hydrogen, alcohol, ammonia, and many other potential fuels, but that the principal consideration is to make sure that fuel resources are used as efficiently as possible.

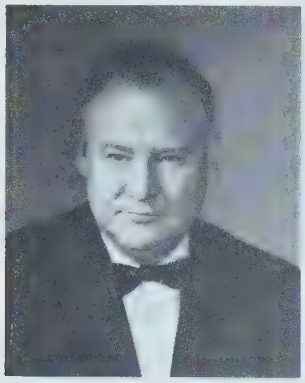
In reply to a question about atomic energy, Dr. Agnew said that atomic energy is certainly a possible energy source for the future—indeed, it is here right now and will become more important as time goes by. He went on to say that General Motors sees no way to make a vehicle power plant that would utilize atomic energy. Dr. Agnew indicated that, at present, atomic energy is a power source for electrical power throughout the country, and eventual use of that power in some battery powered vehicles could be a factor in the future. He concluded, however, that it does not look like it is going to happen to any serious extent in the near future.

A question was asked about how much of the auto emission problem was related to horsepower. Dr. Agnew replied that there has been some confusion over the relationship between the emissions from an automobile and the power output of its engine. He said that many believe that to conquer the emissions problem, all that needs to be done is to build low horsepower engines, but it is not that simple. The emissions from an automobile depend greatly on the amount of work that the engine must do and the efficiency with which the work is done. A given size automobile on a given urban trip will use roughly the same amount of fuel and put out roughly the same amount of pollutants regardless of whether it has a large or small horsepower engine in it. If the large and small engines are not designed correspondingly, the smaller engine may in fact have the higher emissions. Dr. Agnew indicated that surveillance data obtained for cars on the road—such as gathered in California—show that emissions in grams per mile very often are higher from the small vehicle powered by the little engine than they are in the large vehicle powered by the larger engine. If the amount of work the engine does is reduced, if fewer miles are driven, or if a smaller weight vehicle is used, there then is an opportunity to reduce the emissions. This is one of the considerations in the present trend toward smaller size vehicles.

INTRODUCTION TO DISPLAYS

Dr. Paul F. Chenea

DR. PAUL F. CHENEA *joined General Motors in 1967 as Scientific Director of the Research Laboratories and became Vice President in charge in 1969.*



Dr. Chenea received a B.S. degree from the University of California in 1940 and a M.S. degree in 1947 and Ph. D. degree in engineering mechanics in 1949 from the University of Michigan. He was an associate professor of engineering mechanics at the University of Michigan when he left there in 1952 to become head of the division of engineering sciences at Purdue University. He became Assistant Dean of Engineering at Purdue in 1953 and other subsequent assignments at Purdue included Associate Dean of Engineering, head of the School of Mechanical Engineering and acting head of the Division of Mathematical Sciences. He was visiting Webster professor at Massachusetts Institute of Technology in 1958 and 1959. Dr. Chenea was named Vice President for Academic Affairs at Purdue in 1961 and was serving in that position when he joined General Motors.

Dr. Chenea is a Fellow of the American Academy of Arts and Sciences and the American Society of Mechanical Engineers. He also is a member of many engineering, scientific, and educational societies, including the National Academy of Engineering. He has written numerous technical publications and is the recipient of five honorary doctorate degrees.

In the short time available this morning, we have tried to summarize what we have done, where we are today, and how we think we are going to proceed in dealing with safety and environmental problems facing General Motors.

We have now arrived at the "show and tell" part of our program. From now until lunch time, we will be showing you some of the hardware that is evolving from our safety and emission control studies, as well as telling you about some of the sophisticated facilities we are using at the Technical Center.

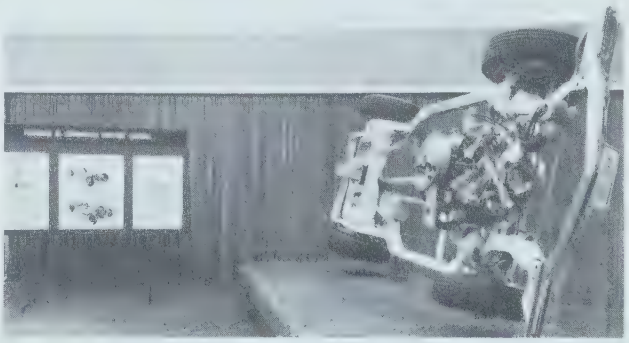
Here in the Styling Auditorium are displays on the experimental safety vehicle, the rotary combustion engine, and automotive emission control systems. You will hear a brief run-down on key features of each display by the man who directs that particular activity.

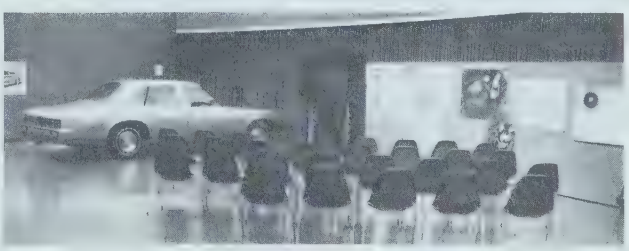
Up at the other end, you'll visit the Research Laboratories, where displays are set up to show you some of the tools we are using in trying to gain a fundamental understanding of atmospheric photochemical reactions, the effect of engine variables on emissions, and the responses of physical and human structures to impact. Again, the people directing these activities will be on hand to brief you and answer questions.

(At the conclusion of Dr. Chenea's remarks, the conference participants viewed the displays. The brief presentations made at the six displays, and the resulting discussion, appear on pages 36-52.)

Automobile Safety Display

Automotive Emissions Display





Experimental Safety Vehicle Display

36 GM EXPERIMENTAL SAFETY VEHICLE

John W. Rosenkrands
Manager, Experimental Safety Vehicle Group, Environmental Activities Staff

In early 1970, General Motors responded to a Department of Transportation (DOT) request for bids to design, develop and deliver two prototype experimental safety vehicles. We subsequently agreed to take on this job as a public service for the contract price of one dollar. Two other companies were also awarded contracts for the same assignment at the same time. More recently, another auto manufacturer has become a contractor.

During 1971, the DOT's program has taken on worldwide proportions in conjunction with President Nixon's "Committee for Challenges to Modern Society." Most auto manufacturers in the free world are now engaged in some sort of safety vehicle development activity.

The program is an attempt to incorporate many new and unproven concepts into a single car, to see if they are compatible. Our contract reflects GM's willingness to cooperate with the government in programs that may accelerate innovations to improve the safety performance of our vehicles.

The Experimental Safety Vehicle built by GM (Figure 43), called ESV for short, so far has been tested in two 50 mph barrier crashes. Six more cars will be consumed this spring in further tests. Our primary purpose is to test new safety concepts in crashworthiness, occupant protection, and accident-avoidance capability, rather than the development of a car intended for production. It is strictly an engineering exercise and not a feasibility study.

(At this point in the presentation, a film showing barrier crash tests of the ESV was viewed.)

Our challenge has been dummy survival, in contract terms, under the extreme pressure of nearly a half million pound-feet of energy in a 50 mile per hour crash. This is one of a variety of predetermined crash conditions.

In the first 50 mph barrier test, the ESV withstood the severity of impact remarkably well. Its components held intact despite crash distortion. However, all the dummies died—according to contract definitions. This, of course, is no indication of human survivability in a similar speed test.

The ESV is a five-passenger, four-door family sedan with an approximate weight of 4,800 pounds, which is 600 pounds over contract specifications. It has an aluminum V-8 engine delivering 185 net horsepower. The car has over 1,000 pounds of aluminum to keep its weight as low as possible. The structure requires the extensive use of materials that are strong in proportion to their weight.

The ESV has a number of interesting features. Pillars have been removed at either side of the windshield to improve driver vision and reduce the hazard of unrestrained occupants hitting a structural pillar. Only the weather seal remains. The support for the roof comes from a high strength center pillar which provides both side and rollover protection. The side windows are fixed in position to reduce the chance of ejection of occupants in rollovers. Small access windows are provided for toll payments.

(One of the dummies used for testing was sitting in the rear seat.) The dummies themselves represent significant problems for our engineers from several standpoints. They don't always do the same things twice in a barrier crash; they don't always react like a human; they only can represent one size and weight of occupant and the results they give us may not have any relationship to human survivability. At any rate, so far, all of our dummies have died.

One design goal was to protect unbelted dummy occupants in 30 mph barrier impacts without using seat belts. The interior padding is intended to hold occupants in place during such impacts, and to reduce the forces on dummies to acceptable levels.

In 50 mph barrier impacts, an experimental air cushion system approach has been used, but a number of problems remain to be solved before the air cushion can be considered a practical, reliable safety feature.

As yet, we do not know how the ESV tests will compare to actual crashes in traffic. On the basis of our past one and one-half year's work, however, we can draw the following preliminary conclusions regarding the ESV:

(1) Contract occupant protection objectives have not yet been achieved. With design modifications, however, they are probably achievable.

(2) Precise control of occupant kinematics (i.e., body motion) is essential in a totally passive protection system. This means that everything in the interior has to be tailored to program occupant position and velocity during impact.

(3) The design for control of kinematics needs to be restricted to a specific dummy design. Designing to accommodate a full-size range of dummies is considerably more complex.

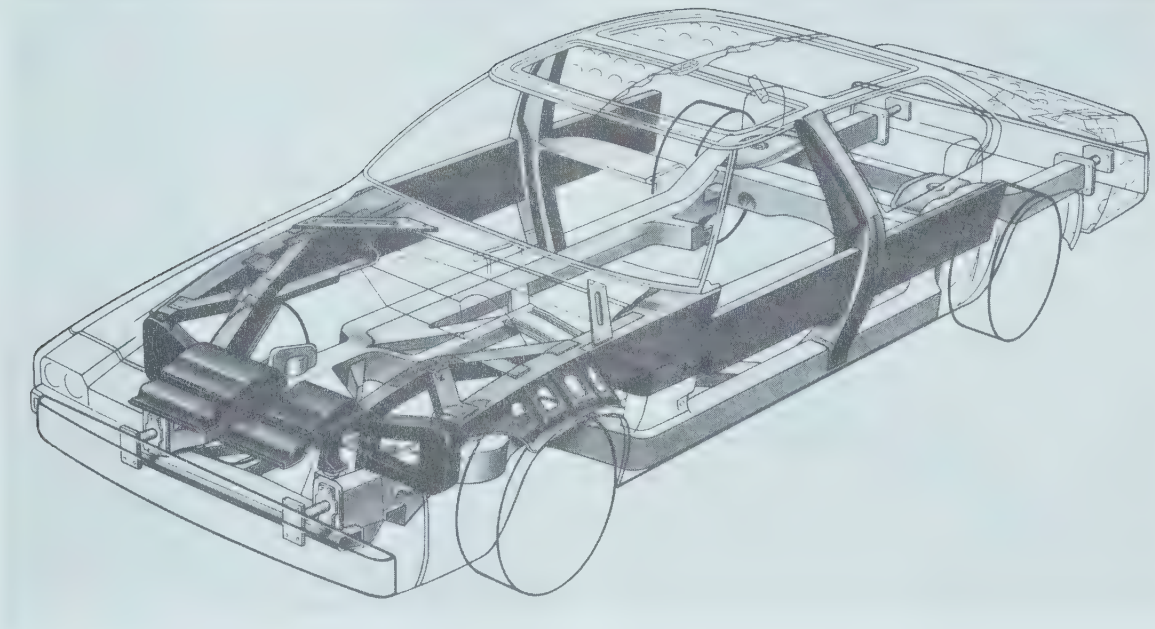


Figure 43

(4) Structural requirements in the contract restrict our ability to optimize structure for occupant protection. This refers to such things as the 10 mph, no-damage bumpers. They may cut insurance costs, but do so at the price of increased risks to occupants in high speed crashes.

(5) The necessary structure can be achieved within the specified exterior dimensions. However, the interior space and entrance and exit accommodations, particularly in the rear, are unacceptable.

(6) Structural requirements, if achieved with conventional materials, would result in an excessively heavy vehicle. The resultant use of lightweight materials adds significant costs to the extent that such a vehicle would not be marketable.

With this completely new development tool, GM is approaching its goal of providing an experimental car with a familiar configuration and the roadworthiness of a medium size American product of the 1970's—and all within the constraints of the DOT performance specifications.

Discussion Period

In reply to a question as to the responsibility for establishing the ESV specifications, Mr. Rosenkrands stated that the ESV contract was part of Phase II of a three-phase program established by the DOT. Phase I consisted of a study by non-industry organizations to recommend a set of specifications for a safety vehicle. This phase was completed in 1969 and resulted in a request for a proposal in early 1970, to which the ESV program is a response. Phase III of the program includes governmental testing of a series of ESVs. Mr. Rosenkrands further stated that GM did not challenge the specifications once they were established, but instead decided to provide a car as close to the required specifications as possible.

An individual asked for some comment on what would be done by the overall automotive industry with the information generated by this program. Mr. Rosenkrands responded that the intent of the DOT was to utilize the results of the ESV program to influence future rule-making. Mr. Rosenkrands added that the experience gained would certainly add to the knowledge generated through all the other on-going research programs.

In answer to a question as to the reason for the ESV bumpers being recessed into the body of the vehicle, Mr. Rosenkrands stated that it only looks as if the bumper is an integral part of the body—in reality the bumper may be pushed backwards nine inches and still be far enough out to protect the sheet metal and, furthermore, it will restore itself to the original position after impact.

A question was asked as to whether anything special was built into the ESV structure to handle large crash loads after the bumper impact had been completely utilized. Mr. Rosenkrands responded that while the frame and front sheet metal structure must provide strength and stiffness to support the engine and suspension for normal driving, every structural member ahead of the firewall is designed and programmed to collapse in a specific manner and sequence after the front bumper impact cycle.

Another individual inquired into the reasons for not using energy absorbing systems similar to those found on jet aircraft landing gear to provide crash protection, to which Mr. Rosenkrands responded that hydraulic energy absorbers are used to support the bumper. However, he also stated that to absorb the energy in impacts above 10 mph, it is more economical from a weight savings point of view to utilize the frame and front sheet metal structure which must be there anyway to support the engine, suspension and all the other mechanical components.

When asked whether the 10 mph bumper increases the hazards to the vehicle occupants, Mr. Rosenkrands replied that the structure necessary to support such a bumper system does cause a stiffer construction which results in a harder interior impact in high speed crashes.

Responding to a question on the cost of the ESV, Mr. Rosenkrands stated that the vehicle was not designed for production although production techniques were used wherever practical. A realistic cost figure cannot be given for a vehicle developed for such a specialized purpose. But as an example, most of the body panels and front end sheet metal were made from aluminum, and just the raw material cost alone is more than twice the price of steel. Furthermore, twice as many weld spots were needed, and each weld required a higher degree of control and sophistication. Also, where steel was used, a high strength alloy has been substituted for lower cost conventional steel.

Noting the large size and weight of the ESV, a questioner asked for a reconciliation of development of this type of vehicle with the growing trend of smaller vehicles, to which Mr. Rosenkrands responded that the ESV was unique. It was specifically designed to protect its own occupants —the object was not to protect the occupant of other vehicles, large or small. This question has to be reconciled apart from the present ESV program, Mr. Rosenkrands added.

ROTARY COMBUSTION ENGINE

Robert J. Templin
General Project Manager, Special Product Development Group

There is considerable conjecture in the popular technical press about the rotary combustion engine. This brief discussion is intended to separate the wheat from the chaff and put into clear focus the reasons for GM's interest in this engine.

First, let's review the terms of the General Motors license with Audi NSU/Wankel G.m.b.H. and Curtiss-Wright. The GM license is unique in that it provides paid-up worldwide rights for GM or any subsidiary to manufacture and sell this engine without royalties, in any size, for any purpose, to any customer, with the sole exclusion of aircraft propulsion. The license is being paid for on a schedule of instalment payments—five million dollars initially in 1970, approximately ten million dollars each year for a period of four years (1971 through 1974), and then a five million dollar final payment in 1975. If at any time during this period we do not wish to make the remaining payments, the agreement can be cancelled. If, however, during the payment period we decide to manufacture and sell engines, we may do so prior to completing payment of the fifty million dollars. This license, which is much broader and more complete than any of the other 27 existing Wankel licenses, puts General Motors in an extremely flexible position if we feel this engine is ready for the marketplace.

Now for a review of the reasons for our interest in the rotary combustion engine.

One important reason is packaging. The engine is smaller and lighter than current automotive piston engines of comparable output. In the profiles shown in Figure 44, the dimensions of a 200 cubic inch rotary engine are about half those of the 140 cubic inch Vega L-4, the smallest GM engine in U.S. production. On the basis of output, this rotary engine is more comparable to our production 6-cylinder engine but weighs 30 percent less. Thus lighter, more compact vehicles can be designed around rotary engines. This will be a necessity in the '70's and '80's because of the addition of bulky pollution control devices as well as the need for free crush space in the front of the vehicle to satisfy barrier crash requirements.

The weight saved in the engine, and in the accompanying vehicle designs, is doubly important. This is the only path we know to simultaneously improve fuel economy, vehicle performance, and emissions. For the near term, our market research indicates that the demand for smaller, more functional vehicles is increasing, a demand that can be best met by more efficient vehicle designs, possibly using rotary combustion engines. And finally, on a broader scale, these lower weight, more efficient vehicles that can be designed around a rotary engine permit the greatest number of transportation units to be built for the least consumption of national resources. This is important in the long term because we face a material and energy shortage position at the end of this century.

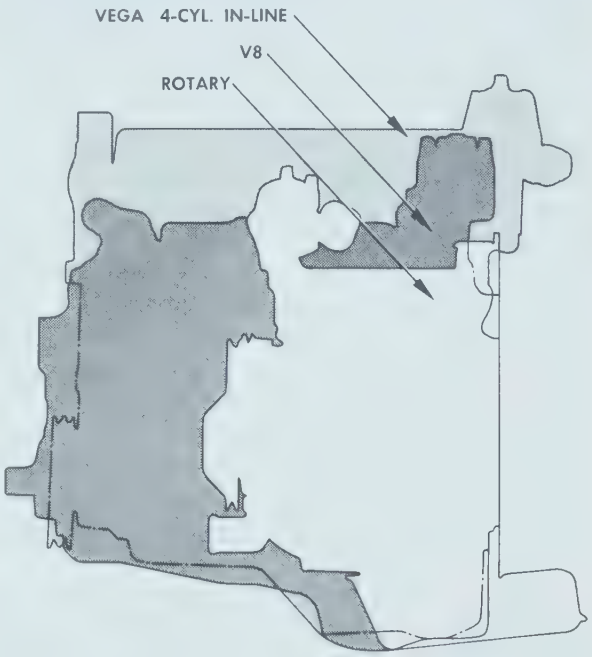


Figure 44

Figure 45 (page 40) shows one aspect of the packaging advantage. The small car shown on the left has a 78-cu in. L-4 engine, which is its standard powerplant. On the right is the same car which has had an experimental 195-cu in. rotary engine installed in the engine compartment space.

Another advantage for rotary combustion engines is manufacturing flexibility. Greater flexibility will be required in the '70's to efficiently utilize any new investment. An investment in the best tooling for a given engine is of no value to us if the market drifts away from a need for this size engine and the tooling cannot be utilized. The market is a volatile thing; we can only forecast it for a few years ahead. As market requirements

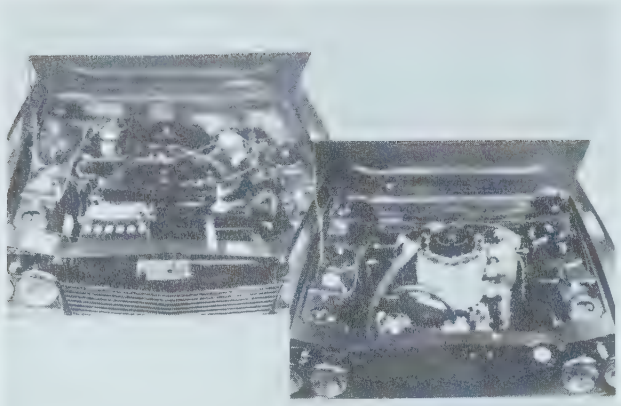


Figure 45

change, we have to be in a position to respond rapidly with any investment we have.

The rotary combustion engine permits a wide range of engine displacements to be built from a common tool investment by varying the width of a single rotor chamber or by building one, two, or even three chamber engines. An investment in this engine, therefore, gives a broad base from which to build efficiently for many different size engines required in the market.

A third advantage of the rotary engine is its operating characteristics. It runs more smoothly and quietly because it can be balanced more perfectly than a piston engine. It has about 40 percent fewer parts than a comparable 6-cylinder engine. The reduction is due mainly to elimination of the valve train which is a source of manufacturing complexity, noise, service problems, and critical materials requirements in a conventional engine. The emission control equipment is simpler since there are either one or two exhaust ports instead of four, six, or eight as with conventional piston engines. The engine has potentially better performance than a conventional engine because it can run to higher rpm's, thus greater horsepower can be obtained per pound or per cubic foot of engine.

Where does the rotary engine stand in the spectrum of development as an automotive powerplant? So far, we have tested well over 100 competitive as well as many of our own rotary engine designs, both on dynamometers and in cars. The results show fuel economy as a major problem. Rotary engines were about 25 percent poorer in fuel economy than the best comparable piston engines. General Motors, however, is making progress in the laboratory to bring this fuel economy up to levels of conventional engines.

In regard to emissions, our tests of current production engines without controls indicate the rotary engine has higher emission levels than the conventional piston engine. However, the same modifications which improved fuel economy made the emission level essentially identical to those of conventional engines. This means that the same technology for external control systems, such as catalytic converters or thermal reactors, will provide the most promising course for meeting emissions standards. Rotary engines with external control systems have already produced emissions results as good as the best piston engine systems.

In the power development area, higher specific power output than piston engines has been obtained. Because of the better breathing of the rotary engine over comparable piston engines, it is hoped that even higher power can be realized from the rotary engine.

The rotary engine has definite inherent advantages but many questions remain. We have not yet established whether the engine can perform up to our standards of customer satisfaction, whether it can meet the durability requirements of the Clean Air Act, or how much it will cost to build.

Fuel economy and long-lasting internal seals were initially serious problems, but General Motors has made good progress in these areas. A great difference exists, however, between essentially laboratory results and the mass production of a product that must perform over a broad range of customer use and climate conditions. We do believe the rotary has strong possibilities. However, our efforts have not yet progressed far enough to warrant any plans by General Motors to mass produce rotary engine-powered cars.

At the present time, 27 other automobile and engine manufacturers are licensed to build rotary engines under various terms around the world. More significantly, however, all the major automobile makers worldwide are either licensed or believed to be in negotiations at this time.

Discussion Period

A question was asked about which firms received the money involved in GM's license payments and Mr. Templin said that approximately 6/11ths is received by Audi NSU/Wankel G.m.b.H., the German patent holders. Curtiss-Wright, holding exclusive rights for manufacture and sale in North America, receives approximately 5/11ths.

In reply to the question as to the timing for possible introduction by GM of a rotary engine, Mr. Templin stated that no definite plans have yet been made for rotary engines in GM cars. He further emphasized that the current objective of GM's rotary engine program was to obtain information on which production and marketing decisions might be made.

In response to a question as to the reason for the smoother operation of a rotary engine as compared to a four-cylinder reciprocating engine, Mr. Templin replied that this was mainly due to the rotary engine being perfectly balanced. All the unbalance forces can be completely compensated with counter-weights in the rotary, but the four-cylinder reciprocating engine cannot be as perfectly balanced. Mr. Templin also added that the rotary engine has more even torque characteristics than a reciprocating engine.

An individual asked whether the engine used regular fuel, and how the rotary might perform in relation to conventional engines for fuel economy and emissions. Mr. Templin replied that a rotary engine would use regular fuel and that in production it could be expected to have performance characteristics similar to conventional engines in both fuel economy and emissions.

42 AUTOMOTIVE EMISSIONS

George W. Niepoth
Executive Engineer, Advance Product Engineering, GM Engineering Staff

Control of emissions from General Motors cars began with the introduction of the positive crankcase ventilation system in California in 1961. Today our cars have controls on all major sources of emissions from the engine. The chassis (Figure 46) has the controls that have been introduced on our cars through 1972 and, in addition, the experimental controls that are being considered for application to future standards.

Figure 46

The 1972 production controls include, first of all, the positive crankcase ventilation system which routes unburned hydrocarbons from the crankcase of the engine back into the intake manifold where they are burned. This gives 100 percent control of hydrocarbon emissions from this source.

Second, there is a Controlled Combustion System for controlling exhaust emissions. This consists of a modified carburetor with leaner air fuel mixtures and modified choke settings for less cold enrichment of fuel. Transmission controlled, or speed controlled, spark is used to provide retarded ignition timing for reduced hydrocarbons and oxides of nitrogen. Lower compression ratios are used which give lower hydrocarbons and oxides of nitrogen and make it possible for the engine to run on 91 octane lead free fuel. This is in preparation for catalytic converters which cannot tolerate lead. Finally, an air preheater provides improved driveability with the leaner mixtures associated with the carburetor in this system.

The third control presently used is for the evaporative hydrocarbon emissions from the carburetor and the fuel tank. This consists of a carbon canister with activated carbon to adsorb hydrocarbon vapors from the fuel tank. When the engine is operating the vapors are then purged back to the intake system where they are burned. The carburetor has complete internal ventilation to prevent vapors from escaping to the atmosphere.

With these three control systems, present GM cars have controls on all major emission sources. Our 1971 cars in customer hands give about an 80 percent reduction in hydrocarbons, about 65 percent reduction in carbon monoxide, and about a 30 percent reduction in oxides of nitrogen.

Development in emission control now is aimed toward the much stricter requirements associated with the Federal Clean Air Act amendments and the requirements for 1975. Systems that seem to have the most potential for application to our production requirements for those years also are shown on the chassis. Several systems are in production now on some models. One of these is the Air Injection Reactor which takes air through an air pump and injects it at the exhaust valve to oxidize hydrocarbons and carbon monoxide in the exhaust manifold. Exhaust gas recirculation is another control that will be used and is presently being offered on some models in California, specifically the 1972 Buick. This system takes gas from the exhaust and routes it back into the intake to reduce peak combustion temperatures in the engine and thus reduce oxides of nitrogen emissions.

A major new component is the catalytic converter which oxidizes the hydrocarbons and carbon monoxide emissions that remain after the initial burning by the Air Injection Reactor. Air required by the converter is supplied by the AIR system. An advance carburetor and choke are being developed to deliver more accurately the air fuel mixture required for this system, with altitude and temperature compensation. Electronic ignition is being incorporated to give long term ignition stability through the elimination of the ignition breaker points. With the incorporation of higher voltage and longer spark duration, a wider spark plug gap can be used to ignite lean air fuel mixtures.

Other approaches toward low emissions, not shown on the chassis, are being developed. It does appear that at this time, however, the components shown on the chassis are those that have the best potential for the production situation within the time frame allowed.

We have test cars which have demonstrated hydrocarbon, carbon monoxide and oxides of nitrogen emissions below the maximum allowable levels for 1975. These laboratory cars are equipped

with hand-built systems, and are hand tuned. We have not at this time proven that these components will meet all of the requirements of the 1975 certification in the production situation.

In summary, intensive activity is continuing to develop systems that will meet the 1975 and 1976 emissions requirements. All known approaches are being considered for their emission performance as well as their effect on car performance, fuel economy, driveability and durability.

Discussion Period

In response to a question as to whether the experimental emission control systems will become a permanent part of the vehicle or will need periodic replacement, Mr. Niepoth replied that the majority of the system will be permanent, but regular maintenance will be required. Mr. Niepoth further stated that at this time it appeared that a catalyst would require periodic replacement.

An individual followed this question with an inquiry on how the problem of maintenance of these systems would be handled, and if it would be necessary for a re-education process for mechanics in the field. Mr. Niepoth said that the maintenance of these systems is very similar to the current approaches. He added, however, that these systems are being developed with refined specifications. For this reason, some re-education might be necessary to inform mechanics that they should follow directions implicitly and that there might also be the necessity of upgrading the diagnostic equipment to properly maintain these systems.

A question was asked about the effect on the consumer of these emission systems in terms of operating cost and performance, to which Mr. Niepoth responded that operating costs could be somewhat higher because of the increased maintenance requirements. He further stated that the full-throttle performance of the vehicle shouldn't be downgraded too greatly unless it becomes necessary to recirculate exhaust gas at full throttle, and this could result in a substantial power loss.

In reply to a question as to the extent the oil industry was involved in a program to develop new fuels for use with these systems, Mr. Niepoth stated that various discussions have been held, and the basic requirements of the new systems were known to the companies in that industry. He added that the catalytic converter would require a lead-free, phosphorus-free, and sulphur-free fuel.

In answer to the question on whether there would be any problem from inter-mixing newly developed fuels with those presently being used, Mr. Niepoth replied that the new emission system cannot use present fuels and so some mechanism must be incorporated in the vehicles and in service stations to insure that only the new fuels will be delivered to the equipped cars.

In reply to a question regarding the work of a catalyst, Mr. Niepoth stated that the catalyst lowers the temperature at which oxidation of hydrocarbon and carbon monoxide occurs in the exhaust. Therefore, he added, with the catalyst the operating temperature of this unit for oxidation will be in the 1,000° to 1,100°F region as opposed to 1,600° to 1,900°F if no catalyst were present.

Another individual inquired as to whether the equipment on the display chassis would meet the 1975 emission requirements, and Mr. Niepoth responded that it would not meet all of the provisions of the Clean Air Act amendments at this time. GM believes it can meet the emission levels of the standards at the end of the assembly line with some models, but there are other 1975 requirements that are the cause of concern. He further stated that certain experimental cars with the equipment shown had obtained emission numbers that were lower than the maximum requirements for 1975, but that these were experimental systems at low mileage and they did not satisfy the field or durability requirements anticipated in Federal regulations for 1975 models.

In answer to a question as to the basis of the 1975-76 standards, Mr. Niepoth replied that the standards were based on some extreme projections of the need for emission control with a 90 percent reduction from the 1970-71 levels.

Another individual inquired whether GM had a chance to consult on these requirements and standards. Mr. Niepoth replied that no public hearings were conducted with respect to the 1975-76 emissions levels specified in the Clean Air Act amendments.

Mr. Niepoth, in response to a question concerning the introduction dates for various control systems, stated that the Positive Crankcase Ventilation System (PCV) was first introduced in California in 1961 and nationwide in 1963. He added that the exhaust controls were first introduced in California in 1966 and nationwide in 1968 and that the evaporative controls were first applied in 1970 in California and nationwide in 1971.

44 SMOG LABORATORY

Dr. Charles S. Tuesday
Head, Fuels and Lubricants Department, GM Research Laboratories

The General Motors Smog Chamber facility is one of the Research Laboratory facilities involved in studies of air pollution. Although the word "smog" is sometimes used to describe any kind of air pollution, we use the word to describe an air pollution problem in which the automobile is very much involved.

Hydrocarbons and oxides of nitrogen are two major classes of air pollutants. They are emitted by automobiles as well as by many other industrial and combustion processes.

These two classes of air pollutants are relatively innocuous in themselves. It is only when these pollutants are trapped for long periods of time by a layer of warm air (an inversion) in the presence of lots of sunlight that an air pollution problem develops. These pollutants react in the atmosphere to form the products commonly associated with smog—ozone, eye irritation, and visibility reduction. Sunlight is a very important part of this process since it actually provides the energy for the reaction and, thus, this air pollution problem is more accurately named "photochemical smog."

DYNAMIC AEROSOL IRRADIATION CHAMBER

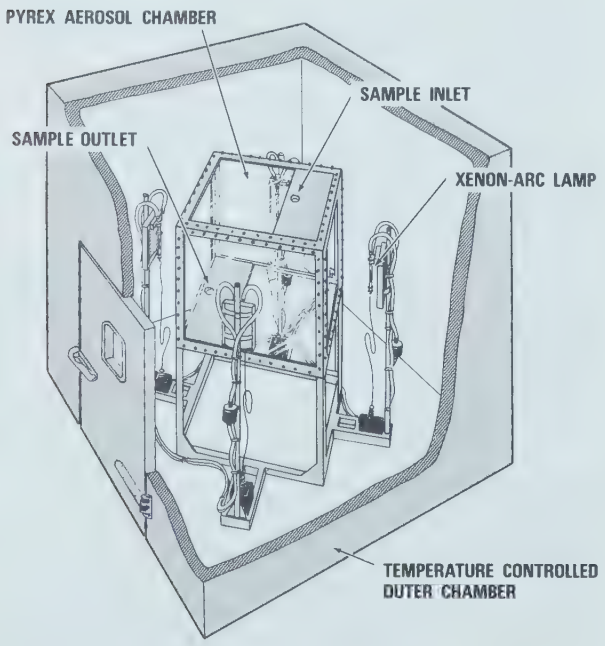


Figure 47

We have been studying this formation of "photochemical smog" for quite some time, using several different methods. In one method, this atmospheric situation is simulated in the laboratory under closely controlled conditions. This is done in what are loosely called smog chambers. We currently have three of these at the Research Laboratories. Each of these has been designed to study a particular aspect of smog, and yet they all have several features in common. They all have a contained volume, an artificial sunlight source, temperature control (because of the disproportionate amount of heat produced by artificial sunlight sources), and appropriate analytical instrumentation.

Our newest smog chamber is specifically designed to study the formation of aerosols in photochemical smog. Aerosols are the tiny droplets responsible for the reduction in visibility associated with smog. This smog chamber (Figure 47), which we call a "dynamic aerosol irradiation chamber," is also used to study the interactions between gaseous pollutants such as hydrocarbons and nitric oxide, and particulate pollutants, such as compounds of lead. The reaction vessel simulating part of the atmosphere is a pyrex glass chamber. Xenon-arc lamps near the pyrex chamber emit light quite similar in spectral distribution to natural sunlight. Unfortunately, they also give off a great deal of heat and, as a result, a rather elaborate temperature control system is required to maintain realistic atmospheric temperatures in the pyrex aerosol chamber. Because aerosols and particulates tend to settle, this smog chamber is based on a dynamic model of the atmosphere — one in which pollutants are continually being added and reaction products continuously being removed.

In our aerosol studies, we have already found, for example, that the kinds of pollutants present in automotive exhaust do not form visibility-reducing aerosols when they react unless another air pollutant—sulfur dioxide—is also present. Electric power generation and other fuel combustion and industrial processes are the main source of this particular pollutant.

Our oldest smog chamber (Figure 48), a long-path infrared cell, was designed in 1956 for fundamental studies of the gaseous reactions that occur in smog formation. This chamber is based on a static model of the atmosphere—simulating the changes that occur in a specific parcel of air.

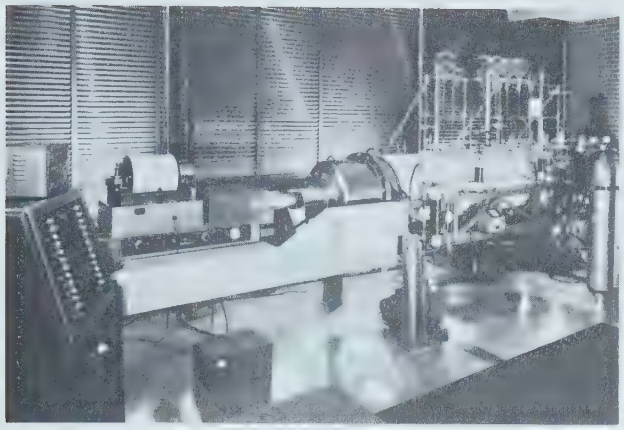
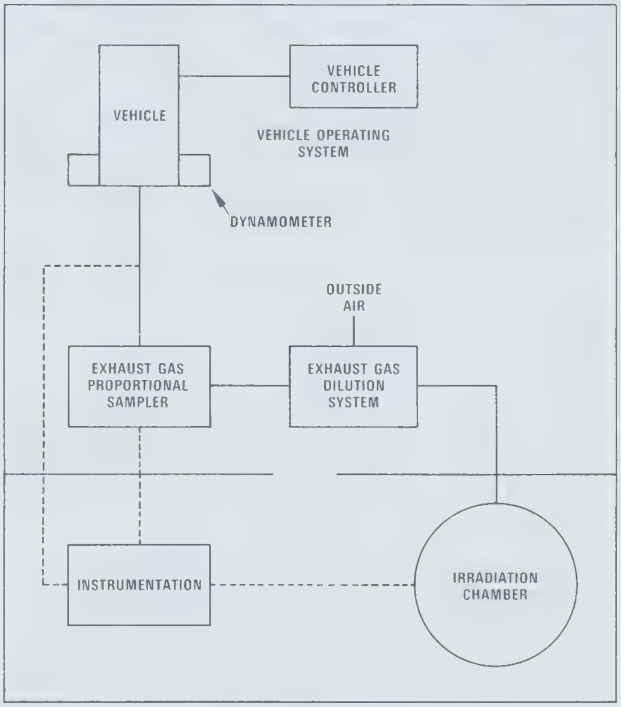


Figure 48

Studies conducted in this chamber have unraveled many of the complex chemical reactions that occur in smog formation. In addition, the reactivities of most of the individual hydrocarbons in automotive exhaust have been measured in this chamber. It has been found, for example, that some of the hydrocarbons in automotive exhaust are quite unreactive and do not form smog, while others have smog-forming reactivities as much as 1,000 times higher.

Our largest and most elaborate smog chamber can simulate either a static or dynamic model of the atmosphere. It was designed in 1960 to study the eye irritation aspect of smog as well as the possible effect on atmospheric reactions of prototype emission control systems and prototype fuels. Artificial sunlight for this chamber is provided by 247 appropriate fluorescent bulbs located in bundles throughout the chamber. Temperature is controlled by the passage of air through these bundles via tubes protruding from the top of the chamber.

The total system is a relatively complete urban model (Figure 49). A vehicle equipped, for example, with a prototype emission control system is driven on a dynamometer by an automatic vehicle controller over a typical urban driving cycle—a cycle containing various accelerations and decelerations, idle and cruise. The exhaust gas from this vehicle is then diluted to the kinds of concentrations found in urban atmospheres. Because of the relatively low concentrations involved, however, the dilution air itself must be purified. The exhaust gas-air mixture then passes into the smog chamber and is exposed to "sunlight". The analytical instruments record the chemical changes that occur and a volunteer panel determines the amount of eye irritation (if any) that develops. This model assumes, for simplicity, that all vehicles in the urban area are equipped as the test vehicle is equipped and driven as the test vehicle is driven. For some studies, other urban air pollutants such as sulfur dioxide—that come from non-automotive sources—also are added to the chamber.



SMOG CHAMBER FACILITY

Figure 49

In studies conducted in this smog chamber, for example, we have found and identified a previously unknown compound that is the most potent smog

eye irritant yet found.

In addition to laboratory investigations of smog, we also have been investigating automotive air pollution in the field. Our first mobile laboratory sampled the air at many sites in New York, Detroit, and Los Angeles, between 1960 and 1966. The results of these studies, together with studies conducted in cooperation with the Sloan-Kettering Institute, established that automotive air pollution was a relatively minor contributor of potential carcinogens in these urban atmospheres.

Our latest Mobile Air Quality Monitoring Laboratory (Figure 50) is a much more complex and elaborate facility. It started sampling the air in New York City last November. This laboratory is equipped to measure all of the meteorological variables and air pollutants that we know how to measure. Because of the volume and the complexity of the data recorded, computerized systems are used. This mobile laboratory is still in New York.

Figure 50

With this mobile laboratory we will not only determine the air quality in various urban and nonurban areas, but we hope we'll be better able to relate the results that we find in laboratory smog chambers to the results we find in the "real world."

Discussion Period

An individual asked for the cause of photochemical smog in Los Angeles and its existence in other cities. Dr. Tuesday replied that a combination of meteorological and topographical effects reduced the ventilation of the Los Angeles atmosphere and thus permitted photochemical smog formation. He added that it was found to a much lesser degree in other cities. Specifically, he mentioned that Florida has substantially less photochemical smog than California.

Responding to a question about results from the mobile laboratory, Dr. Tuesday said that recent sampling in New York City showed when an air stagnation period occurred and when the stagnation broke down by the variation in recorded pollutant concentrations.

An individual inquired if the day of the week might have an effect on smog intensity. Dr. Tuesday said that according to statistical analysis of California data, consistent differences could not be found.

In response to several questions, Dr. Tuesday indicated that GM had several mobile laboratories but that, at present, only one of these was an Air Quality Monitoring Laboratory. He added further that this laboratory was scheduled for on-the-spot sampling in the Washington, D. C. area this summer and the Los Angeles area this fall.

In response to another individual, Dr. Tuesday stated that the large smog chamber has been in operation for about 10 years, the long-path infrared smog chamber for about 15 years, and that the aerosol smog chamber was constructed last year.

An individual asked the identity of the potent eye irritant discovered in the GM studies. Dr. Tuesday replied that the eye irritant discovered was a previously unknown compound and that detailed studies of its structure by GM identified it as peroxybenzoyl nitrate.

In reply to a series of questions, Dr. Tuesday stated that the information developed by these smog chamber studies was published regularly in technical journals such as The Journal of the American Chemical Society, The Journal of the Air Pollution Control Association, and Environmental Science and Technology. He replied further that, to the degree that comparisons could be made, the GM research results generally agreed with those found by other research groups although several minor differences have not as yet been satisfactorily explained.

EMISSIONS LABORATORY

Joseph M. Colucci
Assistant Head, Fuels and Lubricants Department, GM Research Laboratories

In the Vehicle Emissions Laboratory, we are concerned with measuring emissions from all automotive sources (Figure 51). We are obviously concerned with carbon monoxide, hydrocarbons and oxides of nitrogen in exhaust, pollutants for which the Federal government has established standards. But we also are concerned with other exhaust gas emissions, and emissions from many other parts of the automobile.

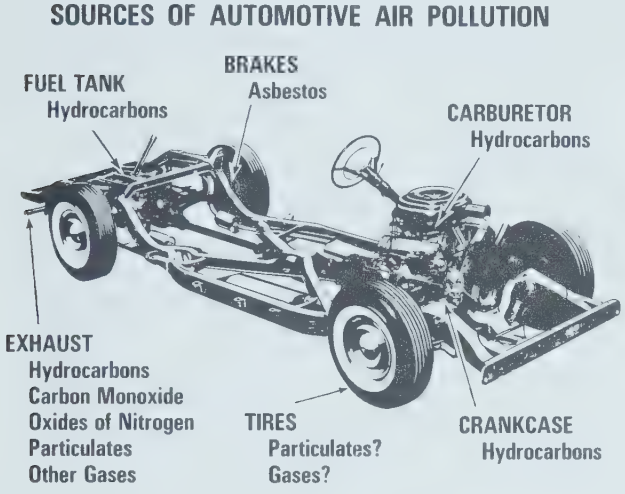


Figure 51

Exhaust gas is a very complicated mixture of gases and particles (Figure 52). Ideally, we would like it to contain only carbon dioxide, water, oxygen, and nitrogen. But since we haven't learned how to obtain this idealized combustion, we find many other constituents such as hydrogen, carbon monoxide, oxides of nitrogen, unburned hydrocarbons, and partially burned hydrocarbons which we call oxygenates. In fact, by using very sophisticated gas chromatographic techniques, we are able to find literally hundreds of different hydrocarbons and oxygenates in exhaust gas. Some of the materials are more prone to form smog than others, and we would like to learn to control selectively the more reactive of these materials.

Exhaust gas also contains particulate matter, or in more common terms, solid materials and small liquid droplets. There is presently no emission standard for particulates. However, we have been investigating particulate emissions so that we will be ready if and when standards are necessary.

One of the difficult parts about this work is making the measurements. Since we are concerned about particles because of their effects on health and atmospheric visibility, we should only worry about those sizes of particulates that cause these effects. However, these size ranges have not yet been established to either our, or the Federal government's, satisfaction. Also, the amount of particulates one collects depends on the temperature of the collection device, and the proper collection temperature and device have yet to be determined. However, we haven't let these problems deter us. With the equipment and instrumentation we have available here, we can determine the mass emission rate, chemical composition and size distribution of the particulates.

So far we've learned that most of the particulates from leaded gasoline is lead, that removing the lead from gasoline decreases particulate mass emissions by as much as a factor of ten, and that the composition of unleaded fuels, the engine air-fuel ratio, and the oil consumption rate can all affect particulate emissions.

In addition to exhaust gas, there are three other sources of vehicle hydrocarbon emissions: the crankcase, the carburetor and the fuel tank. Crankcase emissions have been completely eliminated, so there

Figure 52

is no need to measure them. Carburetor and fuel tank emissions can be measured using an evaporative shed. A preconditioned car is placed in the shed, and left to soak. The evaporative emissions not trapped by the car's charcoal canister escape into the room air, whose hydrocarbon content is monitored. Knowing this concentration, and the volume of air in the room permits us to determine the vehicle's evaporative emissions.

There are two other automotive air pollution sources whose emissions must be measured—namely, tires and brakes. We have made some preliminary studies of both of these emission sources, and during the next year we will get more deeply involved using some new equipment.

At the Research Laboratories, we were measuring exhaust gas emissions long before air pollution became a household topic. Our original measurements were made as part of basic engine combustion studies. The concentrations we measured then were in the percent range. Nowadays, with the gas chromatograph, we can measure hydrocarbon concentrations in parts per billion. Finding a part per billion is like finding one grain of sugar in 100 boxes of table salt.

This increased analytical capability is also used to measure exhaust hydrocarbons, carbon monoxide, and oxides of nitrogen. A test car is driven according to a specific driving cycle. The cycle is 41 minutes long, and is composed of a cold start portion, which lasts 23 minutes, and a hot start portion, which lasts an additional eight minutes after the car's engine has been shut off for 10 minutes. Emissions from these two periods are weighted appropriately to determine the final answers in grams per mile.

The importance of the cold start is evidenced by the fact that about 50 percent of the total carbon monoxide emissions from a prototype 1975 control system occur during the first two minutes of the 41 minute test. While the test vehicle is being driven, all of the exhaust gas is being fed to a constant volume sampler. This device permits us to measure the emissions directly in terms of mass emissions, or grams per mile.

The test equipment and procedures we use are more sophisticated than those used at assembly plant facilities. Since we are doing development work, we continuously measure the pollutant concentrations in the exhaust gas plus dilution air passing through the constant volume sampler. With these continuous measurements we can obtain valuable information which helps us understand why a specific emission control device is, or isn't, effective.

The instruments used to measure the pollutants include: a flame ionization analyzer for hydrocarbons, a nondispersive infrared analyzer for carbon monoxide, and a chemiluminescence analyzer for oxides of nitrogen. The output of the analyzers is continuously fed to a computer. At the end of the test, the computer automatically calculates the emission results and provides a printed output.

With the constant volume sampler system, we have to measure pollutant concentrations in highly diluted exhaust gas, as opposed to direct exhaust gas measurements in the original test procedures. Thus, the pollutant concentrations that we first measured were much higher than those we have to measure now. For example, to comply with the first exhaust standard we had to measure, on the average, a hydrocarbon concentration of 275 parts per million. With the advent of lower exhaust standards, and the change in measurement procedures, we now have to measure an average hydrocarbon concentration of about 4½ parts per million to comply with the 1975 standard. A similar story is true for both carbon monoxide and oxides of nitrogen. The concentrations of these pollutants are, on the average, about 100 times lower than they were during the original exhaust emissions test.

Discussion Period

In response to a question whether GM was making emissions measurements before pollution standards were set, Mr. Colucci said that GM began making exhaust gas measurements specifically because of air pollution almost 20 years ago. He added that this was when the automobile

was first recognized as a source of pollutants contributing to smog in Los Angeles. He indicated further that exhaust emission standards were not effective in California until 1966.

Another individual inquired whether high first cycle emissions could be reduced by preheating. Mr. Colucci qualified his positive response by stating that the emissions generated by the preheater would have to be added to those generated by the engine and that preheaters will add considerable cost and complexity to the system.

In reply to a question concerning emissions from evergreens, Mr. Colucci stated that evergreens, like many other species of plant life, emit a special type of hydrocarbons called terpenes. He added that by themselves terpenes are not toxic but they can react in the atmosphere the same way that hydrocarbon emissions react in Los Angeles air to form smog. He noted that the blue haze in the Smoky Mountains can be attributed, in part, to terpene emissions from the forests.

Another questioner inquired whether large engines pollute less than small engines. Mr. Colucci responded by stating that in our present engine family, large engines generally have lower exhaust emissions of carbon monoxide and hydrocarbons than do small engines. He stated further that there were two primary reasons for this. First, large engines operated at lean air-fuel ratios more often than small engines because they did not have to get into power enrichment (with richer air-fuel ratios) in order to move the vehicle through its driving operations. Hydrocarbon and carbon monoxide emissions are much lower at lean than at rich air-fuel ratios. Secondly, he stated that large engines had lower combustion chamber surface to volume ratios than smaller engines. Thus, since they had proportionately less quench zone than small engines, they had lower hydrocarbon emissions. Hydrocarbon emissions are derived mainly from the quench layer of the combustion chamber, in which the flame cannot get to burn the hydrocarbons.

50 SAFETY LABORATORY

William F. King
Head, Vehicle Research Department, GM Research Laboratories

The General Motors Research Laboratories has the responsibility for developing the basic technology that is required for our vehicle safety goals. Three particularly important needs are: human tolerance data, improved dummies, and structural analysis techniques.

Human tolerance data are the basis for protective systems design. Because of the lack of specific injury threshold data in the medical literature, GM initiated contract research at Wayne State University ten years ago to obtain human tolerance data. Since then, additional contracts have also been established with the University of California for biomechanics research.

On a test sled similar to the one in our laboratory here, Wayne State tested cadavers and determined the fracture threshold for the chest and for the upper leg system (knee, thigh, hip). The chest threshold (1,000 lbs) is the design basis for the energy absorbing steering column, and the leg system fracture threshold (1,400 lbs) is the design basis for the instrument panel. Similar work at the University of California with test impactors have established thresholds for the facial and skull bones.

Other items investigated in recent and current biomechanics contract research include: (a) baboon tests of air bag injury potential, (b) cardio-vascular damage from chest impact, and (c) concussion as influenced by the direction of impact (on monkeys).

The injury threshold for brain concussion is complex and is dependent upon both force and duration. General Motors developed an analytical formula involving both force and duration to express the severity index of a blow to the front of the head. This severity index has been accepted by the biomedical profession and is used by the government in safety specifications.

Closely integrated with the human tolerance studies is the activity on dummy development. I want to stress the interrelationship between human tolerances and test dummy response. Human tolerances are determined by testing humans. The vehicle is tested with dummies, and the dummies are instrumented to determine if *human* tolerances are exceeded.

Unless the dummy accurately represents a human, the human tolerances are not applicable. In addition to being of the proper proportions and weight, it is critically important that the articulations and range of motion be correct and that the stiffnesses and damping accurately duplicate human characteristics.

The need for dummy fidelity was dramatized during the development of the energy absorbing steering assembly. The column was designed to yield at a safe chest load but, when tested with dummies, excessive loads were measured. Cadaver testing proved the column to be within human tolerance and also gave clues to the dummy deficiencies: shoulder articulation of the dummy was deficient so the arms and shoulders did not take a proper share of the load, and the rigid chest of the dummy gave falsely abrupt loading.

Right now, we have restraint system hazards which cannot be evaluated correctly with current dummies. Baboon tests of early air bags disclosed internal injuries which could not be detected with dummies. A current difficulty with testing three-point belt restraints is that the head injury index can vary from passing to failing, dependent on the dummy neck construction.

The test sled in our laboratory is presently set up for comparison tests paralleling studies performed by the government at Holloman Air Force Base with human volunteers. We have adjusted the arresting mechanism to give the same deceleration pulse as Holloman and are studying the influence of dummy neck construction on the head impulses measured.

The biomechanics research contracts have provided the information for development of dummy components of proper elasticity and damping. Contract studies are now under way at Wayne State University to compare the system performance of these new components with that of cadavers and volunteers.

A third major program area concerns the development of analytical models for predicting the structural behavior of the vehicle under impact conditions.

In addition to sustaining operational road loads, the vehicle structure must be capable of absorbing the kinetic energy of a collision without allowing the passenger compartment to be violated. In the past this had been handled by experimental barrier testing and modification by judgment. The trial and error method was costly and did not necessarily yield the safest car.

It is possible to use conventional structural analysis in many vehicle problems; but when shape

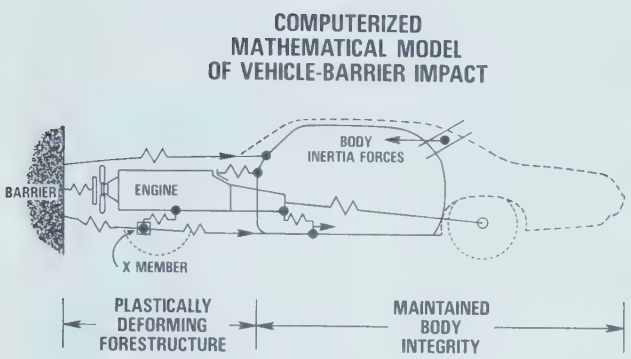


Figure 53

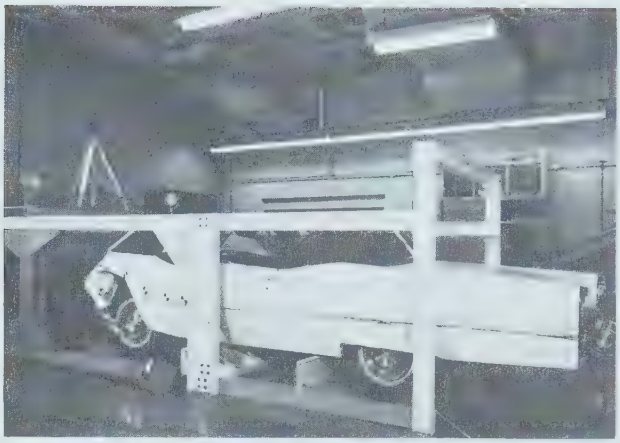


Figure 54

changes, as it does in a collision, the problem becomes vastly more complex.

The Research Laboratories began a program in 1967 to develop additional analytical and experimental tools, applicable to vehicle impact problems.

The first problem addressed was that of barrier impact. Because of the exceedingly complex forestructure behavior of a vehicle, a combined analytical-experimental approach was taken.

The mathematical model is shown in Figure 53. The structure is divided into three masses—the engine, the body, and the engine cross member. The resistance to crush is represented by a number of sub-structures; the sheet metal, the front frame, the torque box region of the frame, etc.

The force-displacement behavior of the individual members is measured in the crusher (Figure 54). This force-vs.-crush information is used as the data input for a computer program which predicts the barrier impact behavior of the entire vehicle. From the computer is obtained the predicted load and crush at each instant during the impact.

This predictive tool has been quite successful and is now being widely used. Large numbers of theoretical crashes can be made each day to evaluate proposed structural changes or new concepts. Mathematical models have also been developed for rear end impact and for vehicle-to-vehicle impact. At present we are working on angle impacts.

In summary, the three principal vehicle safety programs at the GM Research Laboratories are: 1) obtaining human tolerance data; 2) development of improved dummies; 3) the development of mathematical models for predicting structural impact behavior.

Discussion Period

In response to a question concerning efforts to duplicate the human musculature in dummies, Mr. King replied that only limited data were available on which to include muscular reaction in dummies for high impact levels. Some estimates of muscle reaction in the chest have been made but significant research remains to be done.

An individual asked about the performance of air bags in side impact collisions. Mr. King stated that protection from side impacts was not as advanced as in frontal impacts because of the lack of both occupant-vehicle spacing and vehicle crush space comparable to that in the front. He indicated further that a side impact did not provide as much

time to detect the collision and inflate the air cushion.

In reply to a question regarding the possible use of cadavers rather than the dummies currently used in vehicle testing, Mr. King said that GM does not use cadavers for a variety of reasons including their availability, but does sponsor university research to a limited extent. He indicated that in addition to questions of where such work should properly be done, cadavers vary in size, shape, and strength, and are therefore deficient in the sense of providing a standard and repeatable test instrument. Mr. King then emphasized the need, therefore, to develop a realistic dummy.

A question was asked if GM could share vehicle safety information with other companies. Mr. King stated that basic information such as human tolerance is shared through publication. He stated further that, while GM does not confer with other automobile manufacturers in the development of safety products, information on design and performance is published. As an example, air cushion information was publicly disclosed at the NATO International Conference on Passive Restraints held at Milford, Michigan.

In response to a question referred to Mr. Lundstrom, he stated that about 500 cars are barrier-tested each year and that testing requirements will increase this number in the future.

GENERAL MOTORS AND SOUTH AFRICA

Elliott M. Estes

ELLIOTT M. ESTES, *Group Vice President, has jurisdiction over the Corporation's Overseas Operations.*

He was appointed to this position in 1970, after serving as Group Executive in charge of the Car and Truck Group.

Mr. Estes joined GM in 1934 as a cooperative student at General Motors Institute sponsored by the Research Laboratories. He attended GMI for four years, then studied at the University of Cincinnati, which granted him a degree in mechanical engineering in 1940. He returned to the Research Laboratories and, in 1945, was made a senior engineer. The following year, he was transferred to Oldsmobile Division as a motor development engineer. Following a series of executive engineering assignments at Oldsmobile, he became Assistant Chief Engineer in 1954. Two years later he was appointed Chief Engineer of Pontiac Motor Division and was named Vice President and General Manager of Pontiac in 1961. Four years later, Mr. Estes became General Manager of Chevrolet Motor Division and in 1969 was appointed Group Executive in charge of the Car and Truck Group. He was serving in that capacity when appointed to his present position.

Mr. Estes is a member of the Corporation's Administration Committee and seven of GM's policy groups—Overseas, Marketing, Personnel Administration and Development, Public Relations, Industrial Relations, Engineering, and Research.

The morning session of this conference involved a review of some of the technological aspects of our business, their impact on the environment, and steps General Motors is taking in those important areas of public concern. Let us now consider another matter of importance—the human element—that is, the individual rights of man. My comments today will focus specifically on South Africa, a country where human equality does not exist as we know it here in the United States. This matter has received increasing attention and action, and we felt it was essential to discuss this important matter at today's conference.

As most of you know, a proposal was submitted to our stockholders at the 1971 Annual Meeting calling for the withdrawal of General Motors from South Africa. We do not believe this to be a logical or beneficial action in the interest of anyone—General Motors stockholders or the people of South Africa, particularly the nonwhite population.

The General Motors Position

The General Motors position is that its economic presence in South Africa is our greatest contribution to progress in that country. We believe that through the steps we are taking and the good working conditions and facilities at General Motors South African, we are providing an example for other employers to accelerate the pace of progressive change. A comparison of other employers' actions in South Africa including employment, wage rates, employe benefits and educational assistance, and training of their employes has recently been made. GM was above average in all respects.

It should be emphasized that General Motors is deeply concerned about the complex moral issues which exist in relation to the mandatory classifications of races. Our approach is to help build a climate within which the desired social changes can be implemented. Toward this end, we continually review all areas where progress is needed. On this basis, our continued operation in South Africa is consistent with the best interests of our stockholders and South African employes.

We feel that the black man would be the first to suffer from any serious failure in the process of economic growth in South Africa. Further, any attempt to damage the South African economy or isolate South Africa from the rest of the world may only produce a deeper commitment by the white population to the perpetuation of apartheid.

The real forces for change in South Africa must come from within South Africa itself, from its own people—white and nonwhite. We hope that we can contribute to the minimizing of the chance for violence and maximize the opportunities for peaceful change through increased employment opportunities, wages and other benefits for nonwhites.

Many thoughtful and knowledgeable indivi-

duals on this subject, such as George Kennan, Alan Paton and James Michener, agree we should remain in South Africa.

Basic to understanding the situation in South Africa is recognition that it is not a simple one—it is extremely complex. South Africa is a country of 22 million people with less than 4 million whites currently in control of the destiny of over 15 million Africans and 3 million colored and Asiatics.

Both white and African settled in South Africa at approximately the same time during the 1600's —that is, both can be considered original settlers. The colored and Asiatics came later. The current political control by the whites reflects a series of wars during the 19th century.

GM South African

General Motors South African (Pty.) Ltd. was established in 1926 as a subsidiary of the Corporation at Port Elizabeth, Republic of South Africa. This subsidiary has grown from a small assembly operation to a large manufacturing-assembly complex. This growth reflects the institution by the South African Government of local manufacturing content requirements for passenger cars sold in that country, as well as increased vehicle demand.

GM South African is a very large company by South African standards and represents a substantial investment in facilities. In South Africa, the subsidiary would rank 11th in terms of total assets and 41st in terms of number of employes among the top 100 public companies listed on the Johannesburg Stock Exchange.

By U.S. standards, the operation would rank about 563rd in sales in the Fortune 1000 Industrials. As part of General Motors, however, our operations in South Africa represent approximately four percent of our overseas operations and one percent of the total Corporation.

Currently, GM South African has an assembly plant and a manufacturing plant located in Port Elizabeth, approximately 750 miles south of Johannesburg, in addition to an engine manufacturing plant located at Aloes, outside of Port Elizabeth. Automotive products of GM South African include the Ranger, based on Opel design, the Opel Manta Coupe and Chevrolet Holden design passenger cars, as well as Chevrolet and Bedford commercial vehicles. Supporting the assembly of these vehicles, the subsidiary manufactures components such as engines, radiators, batteries, spark plugs, springs and many sheet metal parts.

General Motors Acceptance Corporation also conducts financing operations in South Africa through its subsidiary, GMAC South Africa (Pty.) Ltd.

Reflecting General Motors continuing efforts, as well as the rapid and expanding industrialization in South Africa, the composition of the labor force at GM South African has undergone a considerable transition.

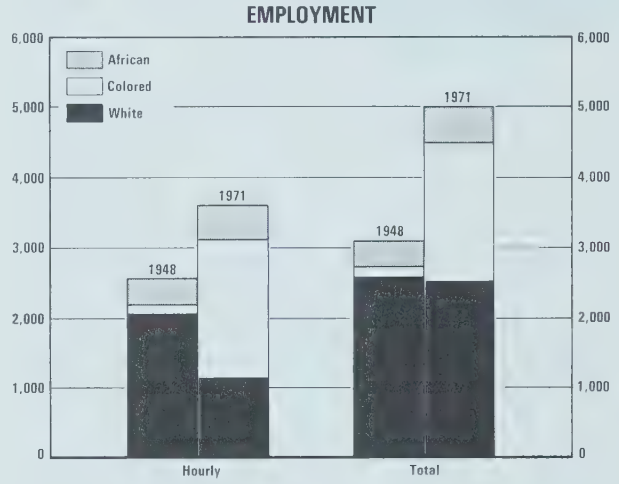


Figure 55

Total employment at GM South African rose from 3,100 in 1948 to 5,000 in 1971 (Figure 55). Total white employment declined slightly. Thus, the growth of 1,900 in the work force was totally in nonwhite employment. As a result, nonwhite employment increased from 17 percent of the total work force in 1948 to 50 percent in 1971.

Total hourly employment rose 1,000 during the period to 3,600 in 1971, while the white hourly force declined and now constitutes less than one-third of the hourly total. Salaried employment increased by 850 to 1,380 in 1971, including 17 U.S. and Canadian citizens. There were no nonwhite salaried employes in 1948; in 1971, GM South African employed 6.

South African Laws

This is our operation as many see it, but one must understand the laws that govern our busi-

ness in South Africa to understand our situation at the moment. Although existing beforehand, apartheid, or the policy of separate development and separate residential areas for the races, became the official position of the South African Government in 1948. At GM South African, we were required to provide three separate sets of facilities —for whites, colored and Africans.

With regard to employment, this racial separation is extensively grounded in the country's existing laws and, therefore, continues to directly affect our operations.

For example, under the *Factories Act of 1941*, GM South African is required to provide separate nonproductive facilities for each race including cafeterias, drinking fountains, rest rooms, plant entrances, etc. for all employes and separate work facilities for salaried employes. Corresponding segregating signs must be posted for each facility.

Another significant law is the *Industrial Conciliation Act of 1956* which reserves certain jobs for employes of a particular race and requires the employment of a specified percentage or number of employes. In 1964, GM South African became bound by a governmental statutory job reservation determination which required that certain specified jobs such as all supervisory and certain types of production jobs such as welding were reserved for white persons. Employers were prohibited from replacing a white employe by a nonwhite employe or a colored employe by an African. Further, all posts occupied by white or colored persons on October 16, 1964 were reserved for white and colored persons. In addition, the order required employers in different parts of the country to maintain certain minimum percentages of white employes.

The *Physical Planning and Utilization of Resources Act of 1967* prohibited increasing without a permit the number of African employes above the number employed as of January 19, 1968. This Act applies to the geographical areas in which GM South African, Ford and Volkswagen are located and to certain other areas of the country.

Abiding by these laws in no way constitutes any endorsement or approval of that country's philosophies, policies or regulations. In fact, General Motors, through the National Association of Automobile Manufacturers of South Africa, has been actively pursuing easements in government restrictions on employment which are based on race.

Easements in Government Restrictions

One example of the kind of progressive influence that GM South African has been able to apply to the job situation in South Africa occurred in November 1968. GM South African, along with other motor vehicle manufacturers, was able to obtain exemption from the 1964 job reservation determination. An agreement was negotiated with the union to significantly reduce the job classifications reserved for whites. As a result, GM South African has been able to successfully move 760 nonwhite employes into some of these formerly reserved job classifications. This has been a positive step toward a broader range of job opportunities being made available to all GM employes in South Africa.

Also, on a number of occasions, GM South African has applied to the government for permission to hire additional African employes. As a result, the number of Africans employed in 1971 ranged approximately 200-300 higher than the levels in mid-1969. In addition, GM South African, through the National Association of Automobile Manufacturers of South Africa, has petitioned against proposed legislation which, if enacted, would restrict African job opportunities.

The situation in South Africa is a crucial one. Progress in human equality must be made. General Motors is contributing to such progress. I would now like to review with you some of the recent forward steps that we have taken.

Progressive Steps Have Been Taken

Of particular significance is the fact that it is now the established policy of GM South African that all employes on like work in like classification with comparable ability and seniority receive equal pay, regardless of race. To implement this policy, in the past year the hourly wage rates of 245 GMSA colored and African employes have been substantially increased. The 245 individuals received wage rate increases averaging 33 percent. Efforts are now under way to broaden the impact of our policy by upgrading our nonwhite employes through intensified training.

We continually review the pay structure at GM South African. GM South African employes are

well paid both in relation to local standards of living and to workers in other industries in South Africa.

Other steps taken by GM South African include the employment, as previously stated, of five colored and one African salaried personnel. While the number of such employes is too small, it has established a precedent for further progress in this area. Since 1970, 119 nonwhite employes at GM South African have entered pre-supervisory training. From this group 13 have subsequently been appointed hourly supervisors of nonwhite employes.

Since Africans are prohibited by law from being represented by unions, an African Works Committee, elected by African employes at all three GM South African plants, has been formed to represent African employes in meetings with management to discuss matters of mutual interest. I might also mention that the meal served daily by the company is the same for all employes—and is served in like facilities. Both the meal and the facilities are above the average for other manufacturing operations in the country.

As part of our current program, the training of our nonwhite employes is a necessary element in improving their skills. In fact, many of the educational and training programs offered by GM South African go beyond those programs offered by General Motors in other countries of the world.

GM South African provides training to prepare new hires for employment, and on-the-job training is constantly carried out for all employes in connection with normal work assignments. In addition, GM South African has started three training programs with all costs reimbursed by the company.

First, a Basic Training Program in reading, writing and arithmetic is being held at facilities available in the African and colored residential areas through adult educational institutions during nonworking hours. Also a nonwhite training officer has begun in-plant training for nonwhite employes who find it difficult to attend outside classes. Fifty-six employes have satisfactorily completed instruction in these classes. Since South African law requires education for whites through 16 years of age, a similar program for whites is not necessary. This is the only GM subsidiary in the world which offers such a program.

Second, a training program to upgrade the technical skills of nonwhite employes is offered at a new outside vocational school in Port Elizabeth during nonworking hours. Subjects offered include mathematics, general drawing, communications and motivation. Nineteen employes have successfully passed an examination on the first phase of their training. Twenty-nine white employes are also attending cooperative technical training classes.

Third, an Apprentice Training Program has also been developed. Four nonwhite repair shop assistants have completed their first semester of classroom work at the vocational school mentioned previously and have started on-the-job training. After completing their training and successfully passing their trade tests, as required under the Training of Artisans Act, they will be promoted to journeyman status. Fifty-three white employes are also in apprentice training in various skilled trades.

Work has also begun on a Manpower Development Plan which will provide training and development opportunities for all hourly-rate employes. Courses offered include human relations and leadership development, job instruction, job relations and effective speaking.

All GM South African employes are also eligible for membership in the Tuition Refund Plan, thus providing them with an opportunity to improve their technical and literary skills. Under this Plan, tuition fees, books, etc. are provided in advance to any employe who wishes to take advantage of the Plan. Advance payment of these costs has recently been implemented because of the lack of colored or African applicants under the Plan during 1971.

In addition, each year over 100 high school scholarships are awarded to children of nonwhite employes. Further, in order to encourage and assist children of African employes to remain in school as long as possible, GM South African has introduced a plan under which the cost of prescribed books and school fees for all children of employes attending government primary and high schools is paid by the company. This plan is of direct benefit to African children who, unlike white and colored children, must pay for these expenses. We expect this program will cover 300 children this year.

Twenty-five years ago, employe benefit plans were available only for white employes. GM South

African employe benefit plans now apply to all employes, irrespective of race. These consist of group life insurance, medical, sickness and accident, and retirement plans. The medical plan at GM South African covers not only its employes but also their dependents as well as retirees and their dependents. All employes also receive a thorough pre-hire medical examination, annual chest X rays and emergency medical service. There are currently two doctors and four nurses, two of which are nonwhite, available at our facilities to administer our programs.

Except for some limitations under the job reservation system, any South African employe can progress to a higher grade position depending upon his ability and job performance.

In another area of personnel development, GM South African has formed a committee to investigate the possibility of providing recreational facilities for nonwhite employes. Such facilities are currently available for whites. Meetings have been held with the Director of Housing of the Port Elizabeth Authority on the subject of acquiring land for play fields and other recreational facilities.

Educational and Financial Assistance Programs

We recognize the value of rendering financial assistance to organizations dedicated to furthering the progress of the nonwhite people of South Africa. We have contributed to the Community Chest, Red Cross, National Cancer Association, numerous hospital funds, educational institutions and various other nonwhite organizations.

In 1948, only two percent of GM South African's contributions went to nonwhite organizations, with 78 percent to white and 20 percent to organizations representing all races. In 1971, nonwhite contributions increased to nine percent.

We have re-examined our educational and financial assistance programs in order to assure that such support is being channeled into constructive, worthwhile programs. As a result, GM South African has undertaken a program to increase the portion of its contribution funds going to nonwhite organizations. In 1972, it is planned that nonwhite contributions will represent 29 percent of total dollars donated.

GM currently supports organizations such as the Inanda Seminary for Girls, an all-African institution, and the South African Institute of Race Relations. Also, we are planning to contribute to the National Study Loan and Bursary Fund for distribution on an equal basis to four nonwhite universities in South Africa. Additionally, contributions to the Association for the Educational and Cultural Advancement of the African People of South Africa and the Bureau of Adult Literacy are also planned.

General Motors supports the United States-South Africa Leader Exchange Program. This Program was organized in 1958 to develop, through nongovernmental means, a mutual basis of cooperation between professional, business, community and religious leaders of all races in the United States and South Africa. A Management Committee of distinguished South Africans and Americans makes the policies and selects the exchangees. The Program exchanges both American and South African leaders, usually for three months, and is supported by American and South African foundations, corporations and individuals.

Representatives of General Motors have attended recent conferences, both in the U.S. and South Africa, and have found this exchange of ideas and positions by representatives of the two countries to be most helpful. These conferences are in addition to our day-to-day contacts with other U.S. companies who have operations in South Africa.

GM Operations Will Continue

General Motors plans to continue to operate in South Africa. Some rumors had, unfortunately, circulated recently in the South African press that General Motors would withdraw from that country. These rumors resulted in a lower level of vehicle sales and employment—primarily nonwhite—at our operation, and an adverse effect on our financial performance. This made little sense. Accordingly, the South African press was advised that General Motors has every intention of continuing its operations in South Africa—in fact, that we currently plan to spend $6 million on our operations in that country during the next two years. These expenditures would provide for new passenger car models, as well as replacement and modernization of our current facilities.

In conclusion, we believe the steps taken by General Motors during the last year and a half

represent substantial progress and constitute an affirmative program to bring our nonwhite employes closer to the goal of racial equality.

We recognize our job of improving the economic and social status of our nonwhite employes has only started and much more must be done, but be assured that General Motors has been, and will continue to be, in the forefront of progressive change in South Africa.

Discussion Period

A questioner, recognizing the positive steps taken by General Motors in South Africa, asked what GM could do further, in view of the South African laws, to justify its continued presence in that country. Mr. Estes replied that while it is obvious that we must live within the laws of South Africa, General Motors is doing everything it can within the laws to reach equality as soon as possible and, in addition, is doing everything it can to get the laws changed, including working through its employers' association.

The same individual questioned how General Motors compared to average figures for the manufacturing sector in South Africa which indicated wages for white workers 5½ times those for nonwhites. Mr. Estes indicated that the average wage of the white workers at GM South African was higher than the average for nonwhite workers, owing primarily to the work grade classifications attained by the various races. Mr. Estes indicated General Motors hoped to advance nonwhite workers, the majority of whom were in the lower job classifications, to higher classifications through the use of training programs.

Another individual inquired as to the number of managerial personnel in South Africa who were American, and what was being done to determine their attitudes toward the improvement of racial conditions in that country. Mr. Estes indicated there were 17 U.S. and Canadian citizens employed in management positions at GM South African. He added that he had visited the General Motors facilities in South Africa twice this past year and had each time reiterated the policies of General Motors. He further indicated General Motors had made some personnel changes to insure that the Corporation had a fresh viewpoint in order to effectively implement GM policies in South Africa. He indicated he would make two more trips to South Africa this year to further insure General Motors is doing everything it can in South Africa.

In response to a question, Mr. Estes outlined the pre-supervisory training program for nonwhites currently in operation at GM South African. The program involves training of 119 hourly employes. Of these, 13 have been made group leaders, the first step toward the position of foreman. It is hoped that by the end of the year, some of these 13 individuals would progress to the next step of foreman.

An individual asked how far a black could progress in General Motors management under the present South African law. Mr. Estes reiterated that by the end of the year it was hoped to have nonwhite foremen at GM South African. He pointed out the limitation under current law that nonwhites can only supervise other nonwhites. Mr. Estes indicated that efforts were being made to increase the number of nonwhite salaried employes, currently six, at General Motors South African, and that training and preparation for salaried positions was the current problem; he did not believe the current law limited nonwhites from progressing from their current levels.

Mr. Estes was asked about a group of institutional investors that had recently visited South Africa and then met with General Motors management. He indicated the group was very constructive in their comments about the general situation in South Africa, and that the exchange of information between the group and General Motors was very worthwhile.

An individual asked what GM was doing to change the nonwhite residency law in South Africa. Mr. Estes indicated the only thing General Motors could do was to keep in contact with the South African Government and register our disapproval

of those laws. He indicated he had done so on his last trip to South Africa. He had talked with government representatives and business leaders, indicating that General Motors certainly could not support and did not believe in the racial policies of the Republic of South Africa—and that General Motors hoped that South Africa would change their feeling about such laws.

In response to a question as to whether a promising South African black who had considerable potential could be transferred out of South Africa into one of General Motors other operations, Mr. Estes stated that he knew of no reason why this could not be done. In response to several questions regarding the movement of nonwhites into South Africa from GM operations in other countries, Mr. Estes reiterated that South African law indicates that nonwhites can only supervise other nonwhites, and that General Motors had not yet tested the actual application of the law. One would assume, however, that nonwhites from another country could supervise nonwhite departments at GM South African.

Another individual asked what General Motors is doing to improve the living conditions of the nonwhites in South Africa. Mr. Estes replied that our main contribution is to continue our program of equal pay for equal work and to make better jobs available to nonwhites. He indicated that nonwhites had currently attained positions in ten of the eleven work grades.

In response to a request for a comparison of General Motors action with that of Polaroid, Mr. Estes pointed out the dissimilarities of the two operations in South Africa—Polaroid operating through a small local distributor, while General Motors maintained a large, wholly-owned manufacturing subsidiary. Mr. Estes indicated he believed Polaroid had a good program. The General Motors program reflected the needs and scope of its industrial operation and, in certain respects, goes beyond the Polaroid program.

An individual asked what steps had been taken toward concerted action by American companies operating in South Africa. Mr. Estes replied that GM South African effected such action through the National Association of Automobile Manufacturers of South Africa. He added that the management of GM South African was virtually in daily contact with many companies regarding current personnel policies and the forward steps it was trying to implement.

An individual inquired whether the restraints in the employment laws had any effect on operating efficiencies. Mr. Estes indicated that this was not a current problem. He emphasized that General Motors is deeply interested in advancing as many nonwhites as it can to the supervisory role. He indicated General Motors is equally committed to advancing nonwhites into higher job classifications through increased education and training.

Another individual asked whether General Motors, as a leader in the field, would welcome legislation proposed in the U.S. that would lay down requirements for all U.S. businesses operating in South Africa. Mr. Estes questioned the effectiveness of such laws and indicated his belief that all American companies, particularly General Motors, are doing everything that can be done in South Africa.

GENERAL MOTORS MINORITY EMPLOYMENT

Stephen H. Fuller

STEPHEN H. FULLER *joined General Motors in November 1971 as Vice President in charge of the newly created Personnel Administration and Development Staff. Mr. Fuller came to GM after a 24-year career at Harvard University.*

He received an A.B. degree from Ohio University in 1941, then entered Harvard Business School from which he received an I.A. degree in 1943, an M.B.A. in 1947, and a doctor of commercial science degree in 1958. He was a member of the faculty of business administration at Harvard from 1947 to 1961, at which time he was named a full professor. From 1964 to 1969, he served as Associate Dean for External Affairs. He was on leave from Harvard while serving as President of the Asian Institute of Management from 1969 to 1971.

Mr. Fuller is active in a number of management development programs overseas, and has special interest in and knowledge of the Philippines. In 1971 he was presented the Presidential Medal of Merit of the Republic of the Philippines.

Mr. Fuller's present areas of responsibility include salaried personnel administration, corporation-wide training programs, manpower recruitment, college relations, executive development, and General Motors Institute.

Opportunity for members of minority groups has been an active concern of GM management for some time. Our efforts have grown apace with the increasing national concern over this issue during the past decade or so.

Let me describe briefly for you where we are and what we are currently doing about equal employment opportunity in General Motors here in the United States.

First, with regard to overall employment—minority employment in GM has grown from 67,000 or 11.2 percent of the work force in 1965 to 89,000 or 15.1 percent at the end of 1971. Today, GM is one of the largest private employers of minority Americans. Very few large companies have a higher percentage of minority employment, and their operations are more concentrated in urban centers than GM which has highly dispersed manufacturing operations. Many of our plants are located in communities where there are few blacks or other minorities in the work force.

General Motors has actively participated in the National Alliance of Businessmen program for hiring and training the hard-core unemployed, many of whom are from minority groups. Although Federal funds have been available, GM elected to hire and train these employes without government aid. By the end of 1971, GM had hired about 59,000 hard-core unemployed under the National Alliance of Businessmen program.

As you are aware, even an employe on our assembly line earns about $11,000 a year. So, the increase in minority employment in our work force through the NAB program and regular hiring has paid real dividends for a large number of minority Americans.

I wish I could report to you similar progress in achieving participation by minorities in our salaried and management ranks. Unfortunately, this is not the case. We are making progress and U.S. salaried minorities in GM increased from 1.7 percent in 1965 to about 4.1 percent in 1971. But we feel the percentage and levels of responsibility achieved are still too low.

The economic climate during the past year and a half has resulted in layoffs or reduced hiring at a number of our plants. The opportunity for hiring new employes has thus been limited and a number of minority as well as other employes have been laid off in accordance with our union contracts and personnel policies. This has slowed our progress in minority recruiting during this period. Hopefully, an improved economy will provide a better climate for our efforts in the coming months.

A high percentage of GM salaried and management jobs require engineering and technical training. Engineers are the largest group of college graduates employed by GM. Few minorities and women traditionally have studied engineering. For a number of years GM has actively recruited at predominantly Negro colleges. But these schools graduate very few engineers and are not a source adequate to meet our needs. Our current efforts are focused on this problem and a number of useful

steps are being taken.

Several of these involve General Motors Institute, a 5-year cooperative engineering college, maintained by General Motors to help supply needed engineering graduates.

First, a substantial increase in the minority enrollment in the regular 5-year co-op program has already been achieved. Steps have been taken to enroll outstanding black and other minority high school seniors in this program which leads to a B.S. degree in engineering and a good start toward a management job in GM. Fifty minority students are currently enrolled in this program and we expect that this will more than double next year.

Our early experience in recruiting blacks and other minorities for GMI showed that many applicants were inadequately prepared in high school for engineering studies. For this reason we have established an experimental pre-freshman program called Pre-Engineering and Management. This curriculum is designed to provide disadvantaged students with training which will allow them to qualify to enter the regular engineering degree program. Fifty-three minority students are currently enrolled in this program.

Another step we have taken to broaden the input of minority students is to establish a two-semester program at General Motors Institute primarily for liberal arts graduates. The program's purpose is to orient liberal arts and other non-technical graduates for employment in industry. The curriculum emphasizes manufacturing processes and supervision, production control and other courses we believe will be helpful to the non-technically trained individual beginning a career with General Motors. We anticipate that most of the expected enrollment of 100 entering this program in the fall of this year will be from predominantly black colleges and minority and women graduates from other institutions.

These three programs will bring minority enrollment at GMI to an estimated level of more than 250 next year. As these students complete their programs at GMI they will provide a significant source of minority college graduates and a major supplement to our recruiting efforts on other campuses.

Along with our efforts to hire the disadvantaged and qualifiable as well as qualified individuals for factory jobs, we have established various programs to assist employes who are disadvantaged by lack of education or experience. These include adult education and other programs to help employes who have not finished high school to pass high school equivalency tests. Some locations have established basic literacy and elementary math programs. Many of the participants in these programs are minority Americans.

Special emphasis is being placed on increasing the participation of minorities in the skilled trades. Many GM plants have programs designed to increase the formal educational skills of prospective apprentices. These pre-apprentice training programs, most of which are administered in conjunction with local school systems, emphasize the study of mechanical principles and mathematics. This added schooling has been helpful in increasing the number of blacks who enter apprenticeships for the skilled trades.

GM's employe educational programs also include a tuition refund program which reimburses the employe in an amount up to $500 per year for satisfactory completion of approved courses in recognized educational institutions. In 1971, 16,000 GM employes participated in this program in the U.S. and Canada.

We also have a Corporation-wide management training activity designed to help supervisors understand the special needs and attitudes of minority employes and to encourage them to take positive action to speed the upward mobility of minorities. The skills of our employes are inventoried regularly to identify those capable of moving up to higher positions of responsibility.

Our efforts in equal employment opportunities are not confined to minorities. We are also giving priority attention to increasing opportunities for employment and advancement of women. While GM has made progress in this area, more needs to be done. A number of steps have been taken or are underway, as indicated by the following:

- One division that employs a high percentage of female production workers has 24 women in training to become production supervisors.
- Women at several plants have entered the formerly all male province of the highly paid skilled trades in classifications such as electrician and die maker.
- Sixteen women are currently studying to be engineers at General Motors Institute and 12

are in other GMI programs. (This may not sound like many, but it represents progress when one considers that there have been only 3 women graduates since GMI was founded in 1919.)

- We are re-examining the way some of our management jobs are structured and staffed with the goal of assigning greater responsibilities to women.

Our most recent study showed that about 75,000 or one out of eight General Motors U.S. employes were women. About 1,600 of these are in professional, managerial or technical classifications. Since women traditionally have not gravitated toward nor been sought out by companies in the heavy manufacturing industries, we have many opportunities for further progress in this area.

Discussion Period

An individual asked how General Motors was doing in other activities, for example sales and marketing, to increase minority participation. Mr. Fuller stated that the Corporation was very actively recruiting and training people in these areas. He added that corporate-wide management programs are underway for zone marketing managers to tackle the problems of recruiting and upgrading minority people in sales and marketing.

In response to a question as to whether GM had any minority zone managers, Mr. Fuller said that, at the present time, there are none, but there are 70 minority-owned dealerships, of which 16 are owned by blacks.

A question was raised about progress being achieved in assisting minority people in attaining engineering and professional training at institutions other than General Motors Institute. Mr. Fuller indicated that GM provides approximately 1,000 college scholarships a year, but that the recipients are selected by the participating colleges. He also said that the Corporation had notified these colleges of its desire to assist minority people through the scholarship program. Currently, he said, 186 GM scholarships are held by minority people. In addition, he indicated that five black colleges are the direct recipients of such scholarships. Mr. Fuller also stated that GM, along with other firms, is assisting ten black colleges in initiating cooperative business and engineering programs. Currently, he said the Corporation has both a full time chemical engineer at Hampton Institute and a financial specialist at Tougaloo College to develop an accounting program, each for one year.

Another individual asked if GM had a special recruiting arrangement with Atlanta University which is the only black university with a graduate school of business. Mr. Fuller said that the Corporation did and that he had accepted Atlanta University's invitation to visit their campus to further mutual objectives. He also pointed out that General Motors Institute recently conducted a seminar to discuss a new Liberal Arts program at Flint with the presidents or their representatives of twenty-eight black colleges in attendance. At that meeting, he stated GM offered its support and asked the colleges for their help in trying to locate qualified blacks to enter management training programs.

GENERAL MOTORS MINORITY ACTIVITIES

Abraham S. Venable

ABRAHAM S. VENABLE, *prior to joining General Motors, was Director of the U.S. Department of Commerce's Office of Minority Business Enterprise. In May 1971, Mr. Venable joined GM in the capacity of Director of Urban Affairs on the Industry-Government Relations Staff.*

Mr. Venable received a B.A. degree in economics in 1951 and a M.A. degree in economics in 1953 from Howard University. He joined the U.S. Department of Commerce in 1963 and served for a year as a Conciliation Specialist with the Community Relations Service. He then was made Director of the Affirmative Action Program Staff and served in that capacity until 1968, at which time he became a Woodrow Wilson Fellow in Urban Affairs at Princeton University. He returned to the Commerce Department in 1969 and served as Director of the Office of Minority Business Enterprise until joining General Motors.

Mr. Venable is the author of several articles dealing with black businessmen and has been honored by the Department of Commerce for developing plans and assisting the expansion of opportunity to blacks and other minority citizens. The National Business League presented him with its J. P. Napier Award as Government Man of the Year in 1970 and, that same year, he also was presented with the Atlanta Business League's Distinguished Service Award.

As has been indicated, General Motors is trying to meet the difficult and complex problems of equal rights and equal opportunity in a variety of ways. The Corporation's programs from an employment and personnel point-of-view have been outlined. I would like to explain some of General Motors efforts to promote economic equality outside of the Corporation.

In 1969, the U.S. Department of Commerce launched a program to establish 100 MESBICs, which stands for Minority Enterprise Small Business Investment Companies. These are companies owned and operated by established concerns such as General Motors. GM committed $1 million to establish a GM MESBIC named Motor Enterprises, Inc. The purpose of this investment company is to provide "seed" capital and management know-how to help minority Americans establish businesses for themselves.

Under the MESBIC program, the Small Business Administration will loan money to MESBICs to reinvest in minority firms. For every dollar Motor Enterprises invests in minority-owned businesses, the SBA will loan us two dollars for reinvestment. In addition, banks and financial institutions will invest four dollars for every MESBIC investment dollar. Thus, one dollar from General Motors generates two more from the SBA. These three dollars generate twelve more from the financial community—or a total of fifteen dollars for investment as a result of the one dollar invested in Motor Enterprises.

Motor Enterprises was the seventh MESBIC to be established in the United States and continues to be the largest sponsored by one firm. To date, Motor Enterprises has approved loans of nearly $1.2 million to 57 minority businesses in 26 cities in the United States. Financial institutions have committed nearly $6 million to go with the Motor Enterprises loans.

Motor Enterprises loans generally have been limited to cities where our plants are located. There is sound reasoning behind this approach. The new businesses often require management and technical assistance which our GM personnel can provide in such areas as production, engineering, sales, and finance.

The personal involvement of GM people in the problems of the new businesses is as important as the financial assistance. This interaction not only helps the recipient but also helps GM people better understand the problems and frustrations of the black community and other minority groups.

General Motors is also trying to promote greater economic equality through its support of minority-owned banks. These minority-owned banks, through their investments, provide a hope for revitalizing the minority community and for increased employment opportunities. Since 1969, GM has had a program to establish regular deposit relationships in a number of these banks.

Then in early 1971, the government announced a campaign to shift $65 million of private sector money into minority banks. This included deposits of labor unions, foundations, religious, educational and social welfare institutions, as well as corporations. Of this $65 million program goal, $5 million, or about eight percent, was immediately committed by one company—General Motors. This total involves deposits of Federal tax payments, demand deposit accounts and interest bearing certificates of deposit.

General Motors has also tried to improve economic equality by support of minority insurance companies. In response to a General Motors request, the Corporation's primary group life insurance carrier has reinsured $250 million of GM's life insurance business with two major black-owned and operated insurance companies. In addition, about $60 million of property damage insurance has also been placed through a black-owned and operated agency in Detroit.

While the Corporation strives to promote economic equality by these various methods—MESBIC loans to minority businesses, support of minority banks, and minority insurance companies—perhaps the most effective way is to buy from minority businesses and to assist in their development.

General Motors now does business with a considerable number of minority companies, and the list grows each month. The Corporation continually searches for and often assists minority businesses that can serve as GM suppliers.

A firm does not need to be large to be a GM supplier. GM depends on about 40,000 suppliers. About 93 percent of the suppliers with whom the Corporation does $500 or more business in a year employ less than 500 people and 80 percent have fewer than 100 employes. Some are even one-man firms.

As a direct result of purchasing support and management guidance by General Motors, nine minority-owned businesses have come into existence in the last two year. Our purchases from them have amounted to nearly $2 million. The ability of these businesses to produce quality products and services has justified our confidence and support.

Prior to 1968, GM kept no records of how many of its supplier firms were minority owned, but we estimate that it was only a small number. Today there are hundreds. The vast majority of purchases from minority firms today would never have been made without a conscious, planned and determined effort to seek out those companies which could provide products or services that GM needs.

More important than the dollar portion of these programs is the personal involvement of GM people in assisting minority entrepreneurs toward their business objectives. Both partners in this effort are enriched by this experience.

In both GM's MESBIC and supplier programs, the goal of our assistance is to help develop strong, independent competent businessmen who can be competitive and prosper in the marketplace. And while we will give them assistance to attain this end, it can only be temporary until the minority business has developed sufficient business maturity to assume an independent position in the economic community.

General Motors has programs in many other areas to promote human equality. One such area is housing. GM is providing up to $2.3 million in interest-free loans to three nonprofit community organizations acquiring land for low-cost housing projects. The first loan is for up to $1.1 million to an organization in Pontiac, Michigan. The second is for up to $1 million to an organization in Flint, and the third is for about $200,000 to a similar group in Lansing, Michigan.

In addition, General Motors has committed up to $1 million to the National Corporation for Housing Partnerships, or NCHP. The NCHP was authorized under the Federal Housing Act of 1968 as a joint effort of government and private industry to overcome the nation's shortage of low and moderate-income housing.

These four housing efforts supported by GM also will have the potential to provide jobs for minority workers and experience for black contractors as well as better housing for the minority community.

Another area of assistance toward human equality is through direct financial support of nonprofit social and economic welfare organizations. The Opportunities Industrialization Centers of America, or OIC, is an organization established to train minorities for gainful employment in business and industry. This highly successful, nationally known

organization is the first manpower self-help training organization of its kind in the nation.

Until 1971, GM financial assistance to OIC was directed primarily to the local operations in our plant cities. But in 1971, the Corporation helped to establish an automotive mechanics training center in Philadelphia in addition to continuing support of local OICs.

General Motors also makes substantial contributions to other groups aimed toward improving the economic and social conditions of minorities. GM's total support of charitable, service and economic welfare organizations amounted to about $8 million in 1971. General Motors supports many such groups working toward solution of the problems of minorities and the cities, including:

- New Detroit, Inc. (Detroit's urban coalition);
- The Interracial Council for Business Opportunity;
- The National Urban League;
- The National Urban Coalition;
- The United Negro College Fund;
- Over 100 local community funds throughout the U.S.

All of the programs I have mentioned today—Motor Enterprises, the minority bank program, the minority insurance program, suppliers assistance, housing, and social and economic welfare assistance—are trying to provide the economic foundation for progress toward human equality.

The fact that equality is difficult to achieve does not diminish the importance of achieving it. Today all minorities—blacks, Indians, and people of Spanish origin—are being urged to forget their grievances and put America first. The problem is that America has not fully recognized that special assistance and support is necessary to get minorities to the level of equality.

Our goal at General Motors is to help give all minorities a reason to put America first—so that America builds them up after neglecting them for so long—so that we make sure all our citizens are first-class.

While there is a long, long way to go before minority Americans share equally the benefits of free enterprise, that day is coming. I assure you that General Motors and I are working every day to hasten it.

Discussion Period

A question was asked as to how General Motors was helping New Detroit. Mr. Venable stated that Mr. J. M. Roche, former chairman of General Motors, was an initial organizer of New Detroit, Inc., that he had involved himself extensively in its operation, and had committed the Corporation to an active role in a number of ways. Mr. Venable added that GM has been involved in providing not only financial but program and staff assistance to this group and continues to support the activities of this worthwhile organization. He indicated further that Mr. Roche recently had accepted the position of Co-Chairman of the National Urban Coalition, and that New Detroit, Inc. is a local affiliate of this national organization.

CUSTOMER ACTIVITIES

Mack W. Worden

MACK W. WORDEN *joined General Motors with the Chevrolet Motor Division in 1946 as a parts and accessories representative in Kansas City. Three years later he was promoted to business manager for Chevrolet's Kansas City Zone and in 1953 was named business manager for the Division's midwest region. The following year he moved to Chevrolet's Detroit office as assistant national sales promotion manager, and later became national business manager and national owner relations manager. In 1961 he returned to Kansas City as assistant regional manager for the midwest region.*

Mr. Worden was promoted to Assistant General Sales Manager in charge of Marketing for Oldsmobile Division in 1963, and three years later became Oldsmobile General Sales Manager. He then was transferred to the Central Office and appointed Director of the Marketing Staff. He was serving in that position when elected a Vice President in charge of Marketing Staff in 1969.

A graduate of the University of Wichita, Mr. Worden is a member of seven of the Corporation's top policy groups—Marketing, General Engine, Household Appliance, Engineering, Industrial Relations, Personnel Administration and Development, and Public Relations. He serves on the Board of Regents of General Motors Institute and is a Director of the Highway Users Federation for Safety and Mobility.

Today General Motors faces many challenges. Perhaps the greatest of all is anticipating and satisfying the growing needs and desires of our customers.

Three principal issues are associated with most of the criticism that has been directed toward the automobile industry during the past few years. These issues include safety, pollution and consumerism. As indicated this morning, substantial, measurable progress in safety and pollution has been made, and it will continue.

Consumerism, as we all know, has intensified in recent years, partly attributable to a more educated and discriminating customer, but also reflecting a change in consumer attitudes. Today's consumer wants more than just a wide variety of models and optional equipment—he wants better, more dependable products. He wants the manufacturer to stand behind the product with a warranty that is understandable to all parties. He also wants products that are easier and less costly to repair. He wants more built-in safety along with products that do not contribute to a deterioration of our environment. In short, the consumer wants a good product which performs well over reasonably long periods of time without unusual cost and inconvenience—and all for a price that he can afford.

It has always been and is today General Motors objective to design and build sound, durable and reliable products of the highest quality. In addition, we feel our most important objective is to retain customer satisfaction and the loyalty of the owners who buy and use General Motors products. We also recognize, however, that this objective continues to pose many challenges. We do have problems, and we are working hard to solve them.

It is also important to point out that consumerism cannot be dealt with by the automobile manufacturer alone. It is a job for both the manufacturer and the dealer working together.

The challenge related to consumerism can be put into perspective by examining the basic rights of the consumer. Ten years ago, President Kennedy said the consumer has four basic rights. These are: (1) the right to safety, (2) the right to be informed, (3) the right to choose, and (4) the right to be heard.

At General Motors we believe in these rights, and we also believe there is a fifth consumer right —the right to his money's worth. At General Motors we feel we are meeting the test of satisfying the consumers' rights.

I don't believe the first three basic rights have been an issue in the recent intensification of consumerism. As to safety, substantial progress has been and continues to be made. The vehicle fatality rate in the United States has been declining in recent years and is lower than any major country in the world. As to the right to be informed, I know of no product today about which the consumer has more information than the automobile. And

as to choice, the automobile industry presents the potential car buyer in the United States with an enormous range of over 400 different models including imports for 1972. I do believe the fourth and fifth basic rights of the consumer have been at issue—the "right to be heard" and the "right to his money's worth." Let me review some of the marketing activities of General Motors which relate to the fourth and fifth basic rights.

As many of you know, General Motors cars and trucks are marketed almost exclusively through individual retail car and truck dealers in the United States and Canada and through individual distributors and retail dealers overseas. There are about 21,500 retail General Motors dealers and distributors throughout the world with over 45,800 franchises. These dealers operate as independent competitive businessmen and provide the customer with a broad base for selection of both product and dealer. They are the custodians of our product goodwill and in that respect are our representatives to our customers.

At this point, I would like to note that General Motors is continuing its efforts to locate potential minority dealers. We think you will be interested in knowing that these efforts have resulted in providing an opportunity for 70 minority Americans to become General Motors car dealers. Sixteen of this number are black dealers. This compares to only two just three years ago. This is progress, but not enough.

In the search for qualified minority candidates for additional dealerships, we have difficulty finding those with necessary capital or management experience. When we establish a new dealer, we do not want him to fail; we want him to be successful. We do a man no favor if we make a failure of him. In this respect, our Motors Holding Division assists in providing capital for otherwise qualified persons desiring to become dealers, including minority candidates. We also are developing an extensive training program for minority dealer candidates, and the first class in this program is expected to start May 1 of this year.

Going back to our present marketing activities, the General Motors dealer franchise agreement is the foundation upon which each individual GM dealership is built. The network of franchised dealers has provided the most efficient means for marketing and servicing GM vehicles. Under the sales and service agreement offered by GM, dealers are individual businessmen free to sell to any customer regardless of where the customer is located. We feel that GM dealers are the finest retail organization in the country. Yet, there continue to be reported customer complaints that are not resolved at the dealer level—a problem area on which both GM and dealers are working together and hope to resolve.

General Motors works very closely with its dealer organization since it is the dealer and his organization that importantly influence customer satisfaction with our products, particularly in the area of service and the administration of the manufacturer's warranty. The dealer is the first and most important link in the communication between GM and the consumer.

In order to further assure the customer's right to be heard, General Motors, in the Owner's Manual delivered with every new GM vehicle, outlines the following three-step procedure by which the customer may communicate with us in the event a warranty matter or some other situation is not handled to his satisfaction:

(1) Discuss the problem with a member of dealership management.

(2) If the dealer cannot readily resolve the problem, contact the GM Car Division Zone Office—the addresses and telephone numbers are listed in the Owner's Manual.

(3) If the first two steps are unsuccessful, contact the GM Car Division's Central Office Customer Services Department at the address shown.

We are also cooperating with over 200 Better Business Bureaus and independent consumer agencies throughout the country, in addition to consumer related activities of local newspapers. We have given them complete information on how to process any complaint about any General Motors product.

In early 1971, GM initiated a special 90-day customer relations test program in the Chicago area—the "Open-Line"—whereby customers could dial direct, toll-free, the Corporation's Owner Relations Department in Detroit to make comments and suggestions, ask questions or discuss any problems they may have about the GM product they own.

Results of the program were quite revealing. Although less than 100 calls per day were received in Detroit, the number of local calls to Chicago zone offices increased a great deal. This indicated that our three-step procedure is understood by and is acceptable to the owners of our products. However, it was evident that additional manpower

was needed in the zones to handle this increased level of owner interest. This has been accomplished in the very large metropolitan zones, including Chicago, where the largest number of our owners reside.

We feel that our efforts and established procedures, designed to "let the customers be heard," are responsive to that right of the consumer. However, it is at the dealer level that we have the key point of communication. If communications are good there, customer satisfaction can be optimized.

To strengthen dealerships in this respect, car divisions and GM personnel hold special meetings with dealership employes. The purpose is to create a renewed awareness of the importance of treating people as they themselves would want to be treated, stressing the benefits to every employe, regardless of his job within the dealership, and of maintaining good owner relations. During the past three years, 4,086 such meetings have been held and were attended by a total of 136,674 dealer employes. A new series of such meetings is currently being scheduled.

In addition to communicating more effectively with the consumer, General Motors is also concerned with providing him with greater value—his "money's worth." This greater value is not confined to the products we sell, but also includes the services the customer receives at the dealership.

As I said before, the consumer wants a good product which performs well over a reasonably long period of time without unusual costs and inconvenience—and all for a price that he can afford.

Even though GM's quality control and testing programs are far better today than ever before, it still isn't possible to assure that every car off the production line is a perfect vehicle. GM passenger cars average more than 14,000 parts each and, in addition, there are large numbers of options and accessories available. Reliable as our systems are, and they are as good as those for any commercial product, we are still working toward the goal of perfection.

In order to improve the quality of our products, GM holds internal engineering and service clinics aimed at improving vehicle quality and reducing service and repair costs. Product problems received from field reports and warranty claims are reviewed regularly in monthly meetings by members of Corporate and Divisional management. We also conduct an Annual Serviceability Symposium where various components which are involved in service complaints are displayed and evaluated. This activity over the past four years has resulted in substantial benefits for GM customers through the incorporation of design changes which improved accessibility and servicing of units and components. In addition to these formal programs, service personnel have a voice in the development, design and manufacture of our vehicles.

Another area in which GM has made product value improvements is in the area of repairability and serviceability.

GM introduced several innovations in bumper design on most regular-size 1972 cars. General Motors also has improved the match of bumper heights on many 1972 models. These improvements are transitional, however, and will lead to even better systems on 1973 cars.

Additional programs to improve repairability were also under way during 1971, and are being continued. One involves parts not directly involved in a collision, but which are often damaged because of their location. Horns, batteries and air conditioning components are typical examples. By moving these parts to areas less vulnerable to impact, damage may, in many instances, be lessened. In spite of these programs, problems with our products in the hands of consumers do occur.

The efficient operation of our dealer service departments importantly affects customer satisfaction with GM products and establishes a high level of owner loyalty toward the dealer. Our dealer franchise agreement, entitled the "Dealer Sales and Service Agreement," includes equal emphasis on both functions at the dealership. In a desire to assist dealers to further improve service to GM owners, a program was initiated in May of 1971 that provides a uniform and simplified measurement of the dealer's service operation. This program will provide every GM dealer with an annual evaluation of the operation of his service department and will also provide specific recommendations in those areas where improvement should be made.

Another program to improve the condition of new cars when delivered was introduced in March 1971. This involved payment by the division to the dealer for new car conditioning performed when a

car is prepared for delivery. Since full payment for new car conditioning is assured, marked improvement in quality and completeness of the preparation has resulted.

In order to provide improved service to their customers, 5,864 GM dealers spent approximately $655 million for new or improved facilities during the five-year period 1967 through 1971. This added over 253 million square feet of land and over 32 million square feet of building area. Seventy-five percent of the building area, and 35 percent of the outside area, is being used to satisfy customers' service requirements. But even the best facilities possible will not guarantee good service.

Additional factors in providing the customer with good service at reasonable prices include improved service and maintenance procedures, better parts availability, practical warranties and better trained service technicians.

GM recently established a Service Research and Development Section which is responsible for the development of information, procedures and techniques which will enable dealers to further improve their skills in accurately and promptly diagnosing vehicle problems, as well as to improve their service and repair capabilities. To achieve these ends, this Section will continually research new, as well as existing procedures and equipment related to diagnosis and repair.

GM consolidated its parts distribution activities into the General Motors Parts Division in 1969 in order to more effectively procure and distribute replacement parts to car dealers through a network of parts distribution centers. These centers are linked through a computer system. When a part is ordered for a car that is inoperative and that part is not in stock at a dealer's local distribution center, it is immediately shipped from the closest center where it is available. Consumers benefit by obtaining parts more rapidly with a quicker return of their car to service. General Motors management reviews at least monthly with Divisional management the status of parts availability and any special back order situations.

Turning to new car and truck warranties, General Motors has made a special effort to simplify the GM warranty and, therefore, make it more understandable to the consumer. To do so, the provisions of the 1971 and 1972 warranties have been grouped under the following categories:

- Manufacturer's Obligations
- Owner's Obligations
- What to Do If There is a Question Regarding Warranty
- What is Warranted and For How Long
- What is Not Covered by the Warranty (for example, the warranty does not cover such things as replacement of normal maintenance parts, failures due to misuse or cars on which the odometer mileage has been altered.)

We feel that this clarification has not only provided improved communications between GM and the consumer but has also helped the consumer to know what he is receiving when he buys a General Motors product.

Also as in the past, the owner of a GM vehicle is not restricted to obtaining warranty service from the selling dealer. He may obtain the required service from any authorized dealer handling his make of vehicle. In addition, General Motors does not disclaim the warranties of merchantability and fitness for a particular purpose.

GM has also made an important contribution in the area of training for service technicians. We have 30 Training Centers throughout the United States, which since 1953 have provided over 73 million hours of instruction to dealers, sales and service managers, mechanics and other service employes. In 1971, there were 110,000 auto mechanics enrolled in courses offered through the GM Training Centers. These Training Centers employ approximately 255 skilled, full-time instructors and are operated at GM expense.

Also in this area, our Chevrolet Division has instituted a program using mobile vans completely outfitted with service tools and audio-visual equipment to provide dealership technicians with the latest techniques in diagnostic and service procedures.

Our efforts go beyond the scope of our own operations. The Automobile Manufacturers Association (AMA), of which GM is a member, and the National Automobile Dealers Association (NADA) are working on a voluntary certification program for general auto mechanics. The goal of this effort is to certify mechanics after they have met the established requirements. Generally, dealers and independent garage owners would seek to employ the certified mechanics, thus raising the

quality and status of mechanics. The results should be that the consumers will receive better service. Because of its ultimate benefit to our consumers, GM is supporting this program, financially and otherwise.

But GM, other automobile manufacturers, and dealer associations cannot do the whole job. Dealers must focus on customer satisfaction, gearing their operations to respond to his needs. Service can be no sideline in the dealership. Today, the automobile is entrenched as an essential part of American life and is more utility than luxury. This fact has to be recognized by dealers just as we at GM recognize it. Dealers and manufacturers together can never assure customer satisfaction even with the assistance of independent garages and service stations unless the customer himself voluntarily becomes involved. Satisfactory operation of a vehicle requires certain routine scheduled maintenance such as lubrication, oil changes and tune-ups. Unless the customer provides for this maintenance, he will ultimately be dissatisfied when his car fails for lack of care. General Motors is working diligently to point out the importance of routine maintenance to the owners of its products.

In conclusion, I would like to make a final observation. The drive of General Motors to improve product quality and product service efforts is bringing results. Contrary to some reported statements, GM has not experienced an increase in owner complaints. As a result of the programs discussed today, we have experienced a reduction in owner complaints in 1971.

We are vitally concerned with giving the consumer the highest value for every transportation dollar he spends. We want those who buy and use our products to be pleased with them and the type of service they receive. Words alone are not enough. Our performance in this area over the years has been well reflected by the acceptance and purchase of GM products by the public.

This is a business way of life with us. We know our future depends on treating consumers as people, and not simply people as consumers.

Discussion Period

Prior to presentation of his formal remarks, Mr. Worden supplemented the preceding discussion of the Corporation's minority activities. He indicated that the Manager of the GM Dealer Development Program, a black man, is currently conducting meetings with GM's entire wholesale organization for the purpose of increasing the representation of blacks in the Corporation's dealer organization. Further, a 30-week District Manager and Service Representative course is now being conducted at General Motors Institute. Enrollment of 49 students includes 10 blacks.

In response to a question concerning General Motors strength in meeting foreign competition in the low and medium priced range, Mr. Worden stated that it centered on the excellent product offerings by General Motors in this field. He stated that the competitively priced Vega meets the import competition directly, and that the Nova and similar offerings are attractive alternatives. Mr. Worden indicated further that since approximately one-half of the buyers in this particular market are first-time new car buyers, a high quality, competitively priced product, backed by proper sales and service provides a real challenge to foreign competition.

A question was asked if anything is being done to encourage those car owners who prefer to perform their own repair work. Mr. Worden stated that the car divisions have included in their owner manuals information to assist owners in diagnosing and correcting certain operating problems should they occur. He indicated further that the Corporation was not presently considering any self-repair facility independent of the dealer organization for car owners, but that independent operators were active in this field.

In response to an observation concerning the quality of first-time dealer repairs as related to improved customer relations, Mr. Worden responded that even better diagnostic procedures were essential to improve car repairability and customer satisfaction.

CLOSING REMARKS—AN AGENDA FOR ACTION

Richard C. Gerstenberg

RICHARD C. GERSTENBERG *joined General Motors in 1932 as a timekeeper with the Frigidaire Division, shortly after graduating from the University of Michigan with a bachelor of arts degree. He was transferred to the Fisher Body Division, Detroit, in 1934 and two years later joined GM's Financial Staff. In 1949, he was named Assistant Comptroller and, in 1956, became Treasurer of General Motors.*

Mr. Gerstenberg was elected Vice President in charge of the Financial Staff in 1960. He was elected Executive Vice President—Finance and a member of the Board of Directors in 1967. Three years later he was elected Vice Chairman of the Board and Chairman of the Corporation's Finance Committee. His election as Chairman and Chief Executive Officer of GM was effective January 1, 1972.

Active in the educational field, Mr. Gerstenberg is a member of the Visiting Committee for the Harvard Business School and the University of Michigan Graduate School of Business Administration. He also is a Director of the United Negro College Fund, Inc. and is presently Chairman of the UNCF Corporate Campaign Committee. In addition, he is a member of the Business Council and serves on the Board of Trustees and as Vice Chairman of New Detroit, Inc.

You have now heard all the presentations we scheduled. We have covered a lot of ground, and you have been most attentive.

There is little information that I can add to the presentations you have heard today. They and the question-and-answer periods seem to have covered the subjects thoroughly. We hope this Conference has given you a fuller understanding of the breadth and the depth of GM's commitment to advancing our country's social objectives.

I want to thank you—each and every one of you—for taking the time to come here and for showing so keen an interest in our efforts.

As you have seen, the men and women of General Motors are working hard in these areas, and the work is difficult. In many fields, both technical and social, we are breaking new trails. Achievements in these areas are not as easily measured as those in sales, for instance. So I speak for all these men and women of GM under Ed Cole's daily direction when I say that a great part of the satisfaction we draw from our efforts comes from the interest and support we receive from you.

What we have shown you today are elements in what we regard as GM's agenda for action, our concentrated program to assure that GM lives up to the full expectations of the public we serve.

For my part, I would like to add a few footnotes to these excellent presentations.

The Cost of Concern

The work we are doing in several of these areas of social concern—especially in automotive safety and the protection of our environment—is costly. Last year, for example, GM spent $237 million to control automotive emissions and air and water pollution from our plants in the United States. This year, we expect to spend over $300 million for these same purposes.

We must see these numbers in perspective. These are the expenditures of only one company. Others in our industry are also spending great sums for the same purposes. Two years ago, when GM's spending for air-pollution control was only half of what it is now, it was more than what all governmental agencies—Federal, state, and local—were spending.

It should concern every citizen that we are spending these funds even though, as Mr. Starkman has shown, we do not now see how, in the case of automotive emissions, we will be able to meet the standards the government has set for our 1975 and 1976 vehicles. We are trying earnestly, as these substantial expenditures testify, but we do not at this time have the complete solution.

As responsible managers, we are haunted every day by the thought that all these efforts may fall short of the stringent standards. That is, we may take all this money, money that could be spent for other worthwhile purposes, and expend it in a search to meet a standard that, in any case, may not be commensurate with its cost.

We have made considerable progress to date, and further progress is assured. Yet because of the way the law is written, we are in a situation where

only a full 90 percent reduction from 1970-1971 levels is legally acceptable.

First of all, we must understand that environmentalists disagree as to what exactly is the proper level of air quality. How clean is clean? A great deal of what we call air pollution comes from natural sources and the everyday necessities of life, like home heating. Not only is there disagreement as to the proper standard, but there is no real estimate of the cost to our society to achieve the arbitrary goals that are set for us.

But we do know some facts and figures. Our 1973 cars will achieve better than a 50 percent reduction in nitrogen oxide, more than a 70 percent reduction in carbon monoxide, and more than a 90 percent reduction in hydrocarbons, as compared with the uncontrolled cars of 1960. You have seen in our exhibit the several kinds of emission-control equipment we have added to, and integrated into, our cars. This has added cost to the customer, not only in the purchase price, but in higher maintenance and operating expenses.

Now, looking ahead, the National Academy of Sciences has reported to the Environmental Protection Agency and to Congress that the additional equipment to be added to the 1973 models to meet the 1975 standards might add another $214 to the initial cost of each vehicle, along with other added costs for fuel and maintenance.

Even if we assume a low figure—say $200 per car—and consider that ten million cars are now sold every year, this amounts to an expenditure by the American public of $2 billion every year, in addition to increased maintenance and fuel costs. We must ask ourselves, is this the best use of our resources, or could this $2 billion—or at least a good part of it—be better applied to the solution of our society's other serious problems.

This is just to control emissions. In addition, equipment added to meet safety standards has also increased the cost of the vehicle; and there is more to come. Seat belts, for example, do a very effective job of reducing injuries, if they are used. When seat belts were available as an option, relatively few of our customers cared enough to buy them. Today, however, they are standard equipment—that is, everybody pays for them—but only about 30 percent use the lap belts and only 4 percent the shoulder belts. Now, as you have seen, the government is mandating the installation of passive-restraint systems for all 1976-model cars. This will impose extra costs upon the customer and without, in our opinion, sufficient evidence that the new system, compared with the effective seat-belt system, will work as it should.

We in the automobile industry face the serious question of whether the extra cost of meeting all these governmental standards will price our products beyond the reach, not only of those who want them, but of those who need them—men and women who require a car for their jobs or to maintain their standard of daily life. The question of costs versus benefits weighs very heavily upon us. We wish we could make the American consumer more aware of the price he must ultimately pay.

Preparing For Tomorrow

In General Motors, we care a great deal about tomorrow. We know that science and technology will open the way to future progress. Ed Cole spoke of this earlier. And we want to keep abreast of change.

Since we last met, GM, upon the advice of the Public Policy Committee of our Board, has established a Science Advisory Committee. We found and enlisted some of America's best scientists. We asked them to help our Corporation respond to the demands of our rapidly advancing society. Some of these men are known to you. The Chairman of the Science Advisory Committee is Dr. Charles H. Townes, a Nobel Prize physicist of the University of California. The other members are also highly distinguished, and equally qualified. They are: Dr. Raymond F. Baddour, Head of the Department of Chemical Engineering and Director of the Environmental Laboratory at Massachusetts Institute of Technology; Dr. Lee A. DuBridge, former Science Adviser to President Nixon and former President of California Institute of Technology; Dr. Martin Goland, President of the Southwest Research Institute; Dr. Robert S. Morison, Professor of Science and Society in the Program on Science, Technology and Society, and Professor of Biology at Cornell University; and Dr. Robert L. Sproull, President of the University of Rochester.

We asked these foremost scientists to take a good hard look at our operations, with special emphasis on our research activities. We asked them to give us an appraisal of our efforts, and to recommend to us what more we ought to be

doing. Now a year is out. They have looked at us. They have made recommendations; and today I can tell you General Motors has acted upon these recommendations.

In the vital area of research, the Committee told us they were impressed by GM's capabilities and efforts to respond to the problems before us. They felt that GM was carrying out first-class development and engineering. On the other hand, they expressed concern that our present resources in research would not be entirely adequate to continue to deal with our current problems and, at the same time, deal with future problems in the rapidly changing world of science. The Committee observed that today's problems were requiring such extensive attention that not enough work was being done on the problems of tomorrow. So, the Science Advisory Committee recommended that GM engage much more staff in long-range advanced research.

Today, I can announce that we are beginning a major expansion of the General Motors Research Laboratories over the next several years. We will substantially expand our research staff, especially in the areas of atmospheric and bio-medical research, the behavioral sciences, and transportation and urban planning. Our research staff now numbers more than 1,500 people, here at the Tech Center. About 500 are professional researchers. The other 1,000 provide essential supporting services. In addition, we have a complete engineering staff here and complete engineering activities throughout all our operating divisions scattered all across the country. Over the next five years we are planning to expand our professional researchers by almost 50 percent, and we will provide them with proper supporting staff and facilities. This will be one part of our investment to make GM better prepared for tomorrow.

Gentlemen, the slogan of the Research Laboratories is "Imagine a Better Tomorrow . . . We Do." By this exciting new program, we do imagine a better tomorrow; better for our whole society, and better for General Motors, and we are investing money and manpower to make it happen. It is another element of our agenda for action that you should know about.

Toward Equal Opportunity

Mr. Fuller and Mr. Venable have told you of our efforts in minority employment and minority enterprise. There is little I can add, except to reiterate our commitment to equality. I want to assure you today that on this subject we speak the same within General Motors as we do outside. We regard equal employment opportunity as both a moral and a legal issue. We are determined to do what is right, both morally and legally. Last week, in the first talk I made as Chairman of General Motors to a group of our managers and employes, I said this about equal employment—and I repeated it yesterday morning to all our personnel directors. I want to read it to you:

> "As you are all aware, the policy of General Motors Corporation is that everyone will be given an equal opportunity in employment without regard to his or her race, religion, or national origin. This is the policy of General Motors, and every member of management must implement this policy.
>
> "Now, there may be many personal prejudices in connection with this problem. These are being expressed in different ways throughout the country, and each person is entitled to his own opinion. However, the position of GM in these matters is unmistakably clear: there is no room for prejudice in General Motors—and we mean just that. If we have any person at management level in any GM facility who cannot function within this policy, or is not giving it full attention, then he will simply no longer be able to work for General Motors."

This may seem to be strong language, but I assure you it is no stronger than our conviction. We are determined that equal employment opportunity be not only a policy but a fact in every plant and every office of General Motors.

Mr. Estes has told you about the hard uphill progress we are making in South Africa. Our progress to date is not what we would like it to be. It is significant, however. Everyone familiar with South Africa recognizes that the restraints to racial equality are extremely difficult to eliminate. They are deep-rooted, both in law and in the long-standing educational and social disadvantages suffered by the nonwhite population. No one, therefore, should believe that racial equality can be achieved easily or quickly. But neither should anyone doubt that its achievement is inevitable.

We know that, and we believe that what we are doing in South Africa is helping the inevitable happen sooner.

This is how we feel about it, and I want to tell you today that in a few weeks I will go to South Africa. I will visit our operations there; I will talk to our employes, and I hope to some of the community leaders. I will do this to assure myself that General Motors is doing everything that it can to hasten the day of equality.

Safer Cars Not Enough

In the area of automotive safety, you have seen a small part of the enormous efforts by General Motors to make its cars even safer.

We are extremely gratified at the great reductions that have been achieved in highway fatality rates. Preliminary figures for last year indicate the number of deaths per hundred million vehicle miles has dropped to an all-time low of 4.7. In 1934, this was 16.7. It was still as high as 7.0 in 1953. The 4.7 in 1971 is down from 4.9 in 1970 and 5.2 in 1969. Even this, of course, is too many, but it is undeniable progress. And the record in many states is even more impressive.

It is often overlooked that there is a great variance between the rates in different states. For the last full year for which figures are available—1970—for example, Rhode Island had a rate of only 3.0. In New Mexico, the rate was 7.6. Now, we know there are significant differences between these two states, in topography and population density, for example. But there are also substantial differences in the death rates between states that adjoin each other, where topography and density would not explain the differences. For example, it was 4.8 in Indiana and 4.2 in neighboring Illinois. The rate in Connecticut was only 2.7, but across the border in New York it was 4.5.

Now, we did not design one car for Connecticut and another for New York. There is little difference between the cars that are driven in one state as against another. I think these statistics make it abundantly clear that the auto is not the only element of highway safety. The difference in the highway safety records achieved by some states clearly points to the other elements of highway safety: the driver, the road, the laws and their enforcement. The industry has come a long way in making the automobile safer. But we must, as a nation, pay greater attention to such areas as compulsory vehicle inspection, to better traffic laws, to the stricter enforcement of these laws, to better highway design and construction, to better driver education, and to other factors.

We can never speak about our progress, in any area of social concern, without acknowledging that we have still a long way to go. We like to think, however, and we hope you agree, that GM is trying its best to do all that it should in balancing our responsibilities to society with those traditional obligations we owe as managers to our customers, to our employes, to the owners of our business, and to all with whom we deal.

The Balance of Responsibilities

I am new to the job of Chairman, but I am not new to the problems of this office. Every manager of General Motors, every day of his working life, must face up to these responsibilities and find the proper balance among them. In earlier days, the Corporation's responsibilities to society were not as widely discussed and well-defined as they are today. Those, admittedly, were simpler times. We felt that we were doing our whole job when we provided our customers full value for their dollar, when we gave our employes good wages and good working conditions, and when we earned a profit for our stockholders.

Recently our society has come to see corporations as having broader responsibilities. General Motors, like many others, recognizes these higher public expectations. And, as we have demonstrated, we are working earnestly toward their achievement.

We know that business generally is sometimes said to be hostile to change even when it may bring great social benefit. Too frequently in the past the criticism may have been justified. Today, we at GM do not intend to allow that criticism to be justified by any indifference or inaction on our part.

No one, however, should be led to believe that the meeting of an obligation in one area does not sometimes lessen our capacity in another.

There are alternative roads to every objective. We feel that we are in the best position to analyze alternatives, and to point out the costs and difficulties of some paths as they would directly affect our customers, our employes, and our stockholders. We would be negligent if we did not do so. We would be reneging on our responsibility to the

owners of our business if we did not point out the price of progress as well as its benefits.

We of General Motors are determined that as far as our energy, brains, experience, and resources can assure, we will give our customers and our society the maximum benefit at the minimum cost. General Motors has grown over the years for no other reason than that it has provided its tens of millions of customers with just that—with maximum value. We work long and hard to assure that every product we make is worthy of our GM Mark of Excellence. Let me pledge to you that GM is giving a similar degree of dedication to each and every one of our efforts in these areas of social concern. For in these areas, no less than others, we recognize that it is the resources of our stockholders we are investing in the hope of gaining the favor of the customer and the society we serve.

Opportunities For Progress

I want to emphasize how grateful we are to have the opportunities to progress in all these areas. We are always conscious that our ability to progress depends on our business success; we know how much more difficult all this would be if our business prospects were not as bright as they are.

Last year was a record year for auto sales. We expect this year, for the industry, to be four percent to eight percent better than last year's record. Looking further ahead to 1980, we see vehicle sales increasing 30 percent in the United States, and 50 percent overseas. That is great progress, and for us it spells great opportunity. We at General Motors are looking forward to translating our business opportunities into further progress.

We have asked you here today both as the representatives of our stockholders and as some of the most thoughtful representatives of our society. We are asking you to make a judgment and to share it with us, to let us know if you feel that we have achieved a reasonable balance among our responsibilities. If, after you return home, there are any further questions or observations you care to make, we want very much to hear from each of you. Let us know what you think. We need your understanding and your support.

We know that much remains to be done in all of these critical areas. I hope in your appraisal of our performance you will consider: first, the change in direction that has occurred in some areas; the progress under way in all areas; and our management's dedication to further accomplishment.

Again, I want to thank you all for coming, thank you for your thoughts, thank you for your attention, thank you for your support.

GENERAL MOTORS CORPORATION
DETROIT, MICHIGAN 48202

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REPORT OF THE

64TH GENERAL MOTORS STOCKHOLDERS MEETING

COBO HALL □ DETROIT, MICHIGAN □ FRIDAY, MAY 19, 1972

It is a pleasure to send to our stockholders this report of the 64th Annual Meeting of Stockholders, held in Cobo Hall, Detroit, Michigan, on May 19, 1972. The meeting was attended by over 1,100 persons from 18 states, as well as from Canada, Italy and Switzerland.

Represented at the meeting were almost 237,000,000 shares of General Motors common stock, or 83% of the 286,256,532 common shares outstanding. More than 796,000 stockholders, or 61% of the 1,298,871 eligible stockholders, were represented at the meeting either in person or by proxy.

The meeting convened at 1:00 p.m. and adjourned at approximately 7:00 p.m.

R. C. Gerstenberg

CHAIRMAN

REPORT OF THE MEETING

The 64th Annual Meeting of General Motors stockholders was called to order at 1:00 p.m. by Richard C. Gerstenberg, Chairman of the Board of Directors, who presided at the meeting and welcomed those present. Mr. Gerstenberg outlined rules to assist in the timely completion of all the business of the meeting and to achieve a fair discussion of all the issues brought before it.

The Chairman noted the important changes made in the Corporation's By-Laws since the last annual meeting. These changes reflected: organizational changes resulting from the election of Mr. Gerstenberg as Chairman and Chief Executive Officer following the retirement of James M. Roche; an increase in the minimum salary level under the jurisdiction of the Bonus and Salary Committee from $50,000 to $75,000 a year, with the proviso that executives at annual salary rates between $50,000 and $75,000 in positions to be designated by the Bonus and Salary Committee would also come under the Committee's jurisdiction; the establishment of a Nominating Committee, a new standing Committee of the Board of Directors with the responsibility of conducting continuing studies relating to the size and composition of the Board in order to make recommendations to the full Board of Directors; and the reduction of the number of members of the Board of Directors from 24 to 23 effective with the election of the directors at the meeting.

Mr. Gerstenberg introduced and paid tribute to two members of the Board who were not standing for reelection, Mr. Albert Bradley and Mr. John F. Gordon. The Chairman also asked those present to join with him in a moment of silent tribute to three men of General Motors —R. Samuel McLaughlin, Edward F. Fisher and John B. Beltz—who had died since the last meeting.

He then introduced the directors standing for reelection and Mr. Charles T. Fisher III, a new nominee to the Board. Mr. Gerstenberg also introduced Mr. Ross L. Malone, General Counsel, and Mr. George W. Coombe, Jr., Secretary, who were seated on the dais.

CHAIRMAN'S REMARKS

Before reporting to you on the state of our business, let me say first that it is a great personal privilege to be your Chairman. For my entire career—better than 40 years—I have been a General Motors man. I have admired and respected the great men of General Motors who have led our organization over the years.

For me to stand here in their place today is a great yet humbling experience. Three of my predecessors as Chairman are with us today, and have been introduced to you. My greatest wish this afternoon is that I will be able to give our Corporation—yours and mine—the same high degree of leadership.

Last year, 1971, was the best of all years for GM in terms of sales. Under Mr. Roche's leadership, a record 7.8 million GM cars and trucks were sold throughout the world.

Our total sales volume was $28.3 billion, the highest ever. Earnings per share were $6.72, second only to the record of $7.41 back in 1965 and a sharp increase over strike-affected 1970, when we earned but $2.09. Dividends last year were $3.40 per share, a payment of about 50 percent of earnings, partially reflecting the necessity of

restoring our working capital following the costly and lengthy strike of 1970.

I believe it is a significant indicator of the state of our economy that for General Motors—and for many other corporations—record sales levels in recent years have not resulted in record profits.

Rising Costs Around the World

Caught as we were in a squeeze between rising costs and stubborn competition all around the world, our percentage of income to sales for 1971 was 6.8 percent. Profit margins for General Motors have been declining from the recent record 10.3 percent achieved in 1965.

What was happening to General Motors in the late Sixties was happening throughout our entire economy. These were years of inflation. For the years 1965 through 70, compensation per man-hour went up 40 percent, productivity only 11 percent.

As a result, unit labor costs rose 27 percent, and industrial prices rose about 14 percent. The consumer price index went up 23 percent, but in the same six years, car prices rose only 6.5 percent when we adjust for equipment changes.

Continuing inflation accompanied by high unemployment and a weakened dollar abroad persisted into 1971, and led President Nixon to adopt his new economic program on August 15th.

We in General Motors gave the President our immediate support; the next day we rolled back the price increases we had announced 10 days earlier for our 1972 cars and trucks.

We let no opportunity pass throughout the year to demonstrate our support, in deeds and in words. The President said fighting inflation was everybody's job. I am proud to say that in 1971, and in 1972, your Corporation stayed on the job.

We now see evidence that the President's program is taking hold, and the strengthening economy has had its effect on our business. The first quarter of 1972 was the best in GM history in terms of net income and earnings per share. Income for the quarter was $651 million; earnings per share came to $2.26; and our profit margin rose to 8.4 percent from the 7.8 percent in the first quarter of last year. In part, these results were the payoff of programs introduced months earlier to cut costs and improve efficiency.

At our last meeting, your Board of Directors voted a special June dividend of $0.25 per share in addition to the regular dividend of $0.85 per share—for a total of $1.10. In mentioning the dividend, I want to report that we are adopting a Dividend Reinvestment Plan. This will enable stockholders who wish to increase their investments in General Motors to purchase additional common stock at less cost and with more convenience.

In the coming months, we will be mailing you information and application forms for the Dividend Reinvestment Plan. We hope many of you will decide to participate.

The Prospects Ahead

Let me now turn ahead to the prospects we see for our Corporation. In the calendar year 1972, there is every indication that car and truck sales in the United States will again set a record. Our projection, reinforced by an extremely strong truck market, shows the total

U.S. sales for the industry will run about 13 million units, and this would be an increase of about 5 percent over the previous record established in 1971—and we see 1972 being a record sales year for General Motors, too.

It is encouraging to note that the steady annual increase in import sales seems to have halted, and thus all of this year's increase will be North American-built vehicles rather than imports.

For the longer term, covering the remaining period of this decade, we can take no narrow view. Our business is as wide as the world, and we in General Motors have our sights set on all of the opportunities, both here and all around the world. The growth overseas has been nothing short of spectacular. Since the beginning of the postwar recovery, our overseas factory sales have increased better than ten-fold: from 132,000 cars and trucks in 1949 to over 1.5 million last year.

And there are astonishing opportunities for continued growth. As just one indicator, in terms of automobile ownership per person, Europe has twice our growth potential, South America 15 times, and Asia about 50 times. In many areas of the world, car ownership is so low that the market can be considered as relatively untapped.

It will be the automobile and truck that will power these nations to fulfillment of their enormous potentials. Everywhere in the developing world, it is the highway, even more than the railroad, that is pushing into the back country.

It is the automobile and truck, more than any other form of transportation, that will move the people and the commerce of the world in the years ahead.

The new little vehicle which we introduced just yesterday, and which we will begin to produce this month in Malaysia, is a tangible response by GM to the developing world's need for basic transportation. We hope, before you leave, you will inspect this little overseas car in the next room. This rugged, inexpensive, simple, but versatile, vehicle has a singular, and perhaps historic, attraction. It may help open the way to a better life for millions around the world.

In our country and in Canada, the automobile is already woven deeply into the fabric of our daily lives. The present widespread ownership of cars has tremendous implications for the future of our business.

In the United States, about 75 percent of all new cars purchased each year are to replace cars that have served out their economic lives. This strictly replacement demand is the major part of our total demand, and is a solid base for future sales. The remaining 25 percent of new car sales reflects our still-growing population, our ever-rising family incomes and the continuing expansion into the suburbs with their two-car garages.

The combined prospects for sales in North America and sales throughout the world give our industry a very substantial potential for growth. To put a number on it, we estimate that by 1980 worldwide annual sales of cars and trucks will total well over 40 million units, compared with the 30 million sold last year. This is the exciting dimension of our opportunity. Let me assure you that General Motors intends to make the most of it.

Even as we do, we will continue in the remaining years of this decade to make significant progress in building safer and cleaner cars and trucks. Too few people—far too few—recognize the progress the industry has already achieved.

Automobile Travel Safer

Automobile travel in this country today is safer than ever—nearly three times as safe as it was before World War II. It is about twice as safe today to drive in the United States as in Europe and three times safer here than in Japan.

General Motors and other manufacturers—by research and fundamental improvements in occupant protection, vehicle handling, braking, and light and signal systems—have come a long way in making the automobile safer, and the work will continue. It is a never-ending job. As a nation, however, we must devote greater attention than we have to better traffic laws and their proper enforcement, to better highways, to better driver education, to the control of drinking drivers and to other elements of highway safety.

I attach great significance to the wide variances among the rates of highway fatalities in different states. The national rate in 1971 was 4.7 fatalities per hundred million vehicle miles. For the last full year for which state figures are available—1970—the rate was 4.8 in Indiana and 4.2 in neighboring Illinois. The rate in Connecticut was 2.7, but across the border in New York it was up to 4.5.

Now, we did not design one car for Connecticut and another for New York. Because there is no difference in the cars that are driven in these states, the marked differences in the state safety records, I believe, clearly point to the other elements of highway safety: to the driver, to the road, to the laws and their enforcement.

Automotive Air Pollution Declining

Nor is the automobile the chief factor in air pollution. Many people have been led to believe that automotive emissions are responsible for the major portion of the nation's air-pollution problem. However, the most authoritative estimates, from scientists both within and outside the industry, put the nationwide role of the automobile, based on the relative health effects of pollutants in the atmosphere, at somewhere between 10 percent to 16 percent. In some cities, of course, it is more. However, for the nation as a whole, as the Federal Council on Environmental Quality has reported to Congress, automotive air pollution is declining.

Public misconceptions—that driving is more dangerous and that automotive air pollution is on the rise everywhere—are having serious consequences on our industry. We in the industry are deeply concerned about "regulatory overkill," and the billions of dollars that must be spent annually to meet regulations whose benefits have not clearly been substantiated and, in some cases, might be achieved more quickly by simpler and less costly means.

One example is the mandated installation of a costly passive restraint system, like the air-cushion, into all cars built after 1975. This method appears to have potential, at least in the laboratory, although it has not yet been tested or developed for mass production. If—and I repeat, if—we can satisfactorily resolve a number of problems, the air-cushion may be the passive restraint system that we will ultimately adopt. But this, in any case, cannot be done quickly.

Yet the nation could achieve a tremendous advance in passenger safety right now—literally overnight—if the driving public could be persuaded, by reason or by law, to use the proven, sensible and relatively inex-

pensive safety belts which are already installed in better than 85 percent of the cars on the road. Seat belts are in 85 percent of the cars on the road today, but they are used by only about 30 percent of the occupants.

Legislation that would significantly increase belt usage would pay off right now in fewer injuries and deaths, as it has in Australia. We could achieve a dramatic improvement in highway safety—more quickly and more inexpensively than any other way. It is an idea we should all support.

A week ago today, the Administrator of the Environmental Protection Agency announced the decision not to suspend the emission standards for 1975 model cars. We believe this action is most regrettable. We have developed emission-control systems which, in experimental cars, will produce the required low emissions, but only for a limited mileage. As of now, we know of no system that can be mass-produced and still meet all of the 1975 requirements established by the government.

General Motors will continue its all-out effort to develop the technology that will enable us to meet these requirements within the lead time allotted. As we press ahead with this tremendous effort, we are also considering additional courses of action. First, we have 30 days to decide whether we will appeal the EPA decision to the court. Second, we can ask EPA for a new hearing if, after further development, we have new data which we feel would establish the necessity of a one-year extension.

And, of course, there remains the possibility that Congress would amend the Act to establish realistic standards. I can assure you that the public interest is much on our mind, and we are pursuing every means available in order to protect our business, the car-buying public and all our employes and dealers who depend on General Motors for their livelihood.

The Question of Benefit and Cost

This question of benefit and cost deserves the closest and most thoughtful consideration of everyone who builds, sells or buys a car. Well documented independent studies show that the costs of meeting the standards for safety and emission control, as now written, will substantially increase the purchase price and operating expenses of 1976 cars.

In March, the White House made public a significant study commissioned by its Office of Science and Technology. A Committee of 16 prominent public officials, educators and scientists was brought into being to analyze the Regulatory Effects on the Cost of Automotive Transportation (RECAT for short). This objective Committee estimated that compliance with the safety and emission standards by 1976 will increase the average cost of a car to the consumer by as much as $873—$350 more for emission-control equipment, and $523 more for additional safety features. In addition, they estimated higher operating and maintenance costs will run about $65 a car per year.

The Committee's conclusions, of course, have grave implications for our business and for our customers. Unless these present standards are modified, these mandated extra costs could mean that many who want a car or need a car may not be able to afford one. Further, because there is serious concern that the costs may exceed the benefits, many who do buy a car may not be getting full value for their money.

Before this decade is over, we will meet society's

demands for even safer and virtually emission-free automobiles. Still, it is essential that as a nation we set reasonable priorities and realistic deadlines for the attainment of such goals.

Achieving National Goals

General Motors today, like every business, finds itself summoned to help in the achievement of grand national goals—the elimination of poverty, the preservation of our environment, the rebuilding of our cities, the assurance of equal opportunity for every American. These social advances are best accomplished in an atmosphere of prosperity generated by economic growth.

As I have emphasized on other occasions, only the profitable business can help accomplish our national goals. For example, this year alone, General Motors is spending better than $300 million to control automotive emissions and air and water pollution from our plants in the United States. In addition, we have extensive training programs to qualify new employes and to hasten the upward progress of minority employes. We are assisting low-cost urban housing, providing help to minority businesses and insurance companies and adding substantially to our deposits in minority-owned banks. The point we must remember is that such contributions by business to a better society are possible only when the individual businesses are earning profits.

Our American economic system is not only a profit system—it is a profit-and-loss system. Every day, businesses fail. Each failure eliminates a potential contributor to our nation's growth and to its ability to fulfill the aspirations of our people. The company that fails pays no dividends or taxes, hires no new employes, develops no new products, trains no minority Americans and contributes nothing to its community.

More Growth, Not Less

America and the world need more economic growth, not less. Certainly, our growth must be in quality as well as in quantity. It must have order and a common-sense concern for all the values of our civilization, but growth must continue. Because, for those who are struggling for a better life—for those in the slums of our cities, in the hollows of the mountains, in the backwaters of our society—for them, no growth spells no hope. For our country, whose history has been illuminated by growth and progress, to stop now, when so much is yet to be achieved, would be counter to our whole experience as a nation and alien to the very idea of America.

Some in our society do not understand, or are slow to acknowledge, the importance of the automobile and truck in the American experience. Consequently, they do not see serious harm in severely regulating its manufacturers and burdening its buyers. Yet, we cannot wish our critics away, nor would we want to, because we see the best of them as conscientious advocates of constructive change, who are quick to anticipate the public mood. To us in General Motors, the public's desires are always paramount, and we regard change in our industry and in our products as inevitable and welcome. So we are busy preparing to deal with the future, to come to terms with tomorrow.

To us, the prominence of the automobile in American life is a matter of pride, not apology. It is a marvelous product well-suited to the character of the American

people and matched to our native desire and historical need for great mobility. Today, our America is increasingly suburban, and it is the car, truck and bus that are suited to the crisscross travel patterns our people follow in pursuit of their livelihood and their leisure.

We especially need better means of mobility within our urban areas, our central cities. We also know that unless we have good transportation in and out of the city, the traffic and the people will ultimately go only one way—and that way is out.

General Motors has long supported expanded public transit as an essential component of an effective urban transportation system.

We are on record on this subject and have been for a number of years. No company more than General Motors has a greater direct interest in mass transit, for we are the nation's leading manufacturer of buses and locomotives.

Better urban transportation is in the best interests of our business, and it is a job to which we have made and can continue to make significant contributions.

So that is my report on General Motors today. As always, and perhaps more than ever today, it is a dynamic composite of problems, many and diverse, but rich in opportunity.

I did not cover here the many other serious tasks which confront us—the imperative of quality in all of the products we make and in customer service, the urgent thrust toward equal opportunity, the crucial need for greater productivity.

In all these areas, and more, I know that in our Corporation—as in our country—we still have a way to go.

But I am more than ever convinced that we are going to make it—in General Motors and in America.

This, I can assure you. The future role of General Motors will be great; we will continue as an important influence for progress, in our nation and in the world.

On behalf of the management of General Motors, I pledge to you, our fellow stockholders, that our Corporation will continue to fulfill its responsibilities to you—the owners of the business—as well as to our customers, our employes, our dealers and our suppliers. And, at the same time, we will continue to render the fullest of citizen service in every community and every country where we operate.

Thank you very much.

DISCUSSION AND VOTE

Following approval by the stockholders of the minutes of the 1971 Annual Meeting, Mr. Gerstenberg introduced the two officers of C T Corporation System appointed to act as judges at the meeting. He explained that, from the time the first proxy was received, the judges and their assistants had continuous control over the receipt, inspection, handling, counting and tabulation of stockholders' proxies. The Chairman said these arrangements gave stockholders added assurance of confidentiality. Mr. Gerstenberg then reviewed the meeting rules, including the customary limitation of matters discussed at the meeting to those which concern all stockholders, and discussed General Motors' policy of providing job opportunities on an equal opportunity basis and its efforts to provide safe and reliable vehicles.

During the meeting, the following stockholders and

proxyholders spoke: Mr. Irving Bluestone, Mr. Francis Brown, Prof. Dennis Brutus, Mr. John Bucalo, Mr. Edward Calvert, Mr. Fred Colombo, Mr. Robert Coyle, Mrs. Evelyn Y. Davis, Mr. Joseph Emanuel, Mr. Richard Gellott, Mr. Lewis Gilbert, Mr. Karl Gregory, Mr. Walter Hagen, Sen. Fred Harris, Mr. Paul Irish, Mr. Anthony Kassab, Mrs. Rita Leeds, Mr. Vernon Lough, Mr. Donald Mawdesley, Mr. John McCrea, Mr. Jim Mitchell, Mr. Philip Moore, Mr. Paul Neuhauser, Mr. Richard Righter, Mr. Wade Rubick, Dr. Howard Schomer, Prof. Donald Schwartz, Mr. George Sitka, Mr. Timothy Smith, Mr. Philip Sorensen, Mrs. Wilma Soss, Prof. Irwin Tucker, Ms. Nancy Von Steeg, Mr. B. F. Wagner, Fr. Orris Walker and Mr. Houston Wilson.

Item 1 — Election of Directors

The 23 nominees named in the proxy statement were nominated.

A stockholder asked if the Nominating Committee had submitted the name of a woman to the Board. Mr. Gerstenberg replied that no one is excluded from consideration, and said the Committee has advised the directors that it has the matter of a woman nominee for director under active consideration at the present time. The stockholder nominated Mrs. Ruth Sulzberger Golden for the Board, and another stockholder nominated Mr. John Connally.

A stockholder asked if a conflict of interest might exist with respect to one director, who is also a director of a steel company. The Chairman replied that the matter had been reviewed and it had been determined that there was no conflict. A stockholder opposed the nomination of another director because of his association with a bank and an airline. Mr. Gerstenberg replied that General Motors has relationships with about 360 banks in the United States. With respect to the director nominee's relationship with an airline, Mr. Malone said the approval of the Civil Aeronautics Board was required for the nominee to serve on both company Boards, that approval was under active consideration by the CAB, and that General Motors had been advised approval could be expected in the normal course of events. (Approval was received on June 8, 1972.)

A stockholder asked if directors were encouraged to ask questions at Board meetings. Mr. Gerstenberg replied that directors are extremely curious and are continually asking questions, in both Board and Committee meetings, and inquire actively about the business. In response to further questions, he said the directors held 12 meetings during the past year, attendance averaged over 93 percent, and the fee to outside directors was $600 per meeting. Mr. Gerstenberg said the fee was reduced to $100 a meeting if an outside director is a Committee member, and that if he is a member of a Committee, he receives a fee of from $9,000 to $16,500 per year, depending on the Committee. Directors who are employes receive no fees. The Chairman stated further that attendance at Committee meetings averaged better than 95 percent.

A stockholder complimented the Corporation for listing in its Proxy Statement other directorships and activities of nominees for director. A stockholder said he was pleased to hear the Nominating Committee was considering a woman for the Board of Directors, but disappointed that there were so many bankers on the

Committee. The stockholder asked if any members of the Board had ever worked on an assembly line, and whether they could adequately understand the problems of an assembly-line worker. The Chairman replied that the Corporation's Board is composed of men with broad experience who serve all the stockholders well.

In response to another question from the stockholder, Mr. Gerstenberg said the Board has constantly considered its composition and the Nominating Committee will continue to do so in the future and make recommendations to the Board. In response to a final question, the Chairman said if a name were submitted to the Nominating Committee by a stockholder, the Committee would consider it.

The 23 nominees for directors named in the proxy statement were elected. The highest number of shares voted for any nominee was 235,904,232, the lowest 235,841,457. Of the other nominees, Mrs. Golden received 19,270 votes and Mr. Connally received 284 votes. In accordance with the stockholders' directions, a total of 874,506 shares, owned by 9,111 stockholders, were not voted for directors.

Item 2 — Board of Directors Proposal To Ratify the Selection of Independent Public Accountants

The proposal to ratify the selection by the Corporation's Audit Committee of Haskins & Sells as independent public accountants for the year 1972 was presented to the meeting, and the Chairman introduced representatives of Haskins & Sells.

Mr. Gerstenberg noted that the Audit Committee is composed entirely of directors who, under the By-Laws of the Corporation, may not be officers of the Corporation or members of its Finance or Executive Committees. He also said the Audit Committee requires representatives of Haskins & Sells to be available to attend its meetings, both to answer any questions that may arise or to discuss any matter that the accountants may wish to bring to the attention of the Committee. The Chairman said this arrangement gives the Audit Committee a good continuing relationship and understanding both of the operations of the Corporation and the procedures and recommendations of the audit.

A stockholder asked if any recommendations for the improvement of internal controls had been discussed. A representative of Haskins & Sells said any matter which they think will strengthen the internal controls of the Corporation or its divisions is given very serious consideration by the Corporation, and any necessary remedial steps are taken. The Chairman said the Audit Committee extensively reviews all procedures with representatives of Haskins & Sells.

The Chairman of the Audit Committee said that the Committee had very frequent reviews of subjects related to internal controls and, through discussions with Corporation and Haskins & Sells personnel, anything that would improve these controls was continually sought. He added the Committee had no difficulty at all with management accepting the recommendations of either the Audit Committee or Haskins & Sells.

A stockholder asked the amount of income taxes paid by the Corporation to various governmental agencies. The Vice Chairman replied that in 1971, $1,417 million was provided for United States income taxes, $164 million for foreign income taxes, and $203 million for state and local income taxes. Another stockholder later

requested that these amounts be shown in the Annual Report. In response to a question from another stockholder, Mr. Gerstenberg replied that expense accounts are audited by Haskins & Sells and the Corporation's Audit Staff, and every supervisor must approve all expense accounts of people under his jurisdiction. The stockholder asked if there had been losses because of the devaluation of the dollar, and if there had been losses in connection with the Corporation's operations in Chile. The Chairman said the loss on translation of all currencies, including the effect of monetary realignment, for last year ran approximately $27 million and, in the case of Chile, the Corporation had a write-off of about $6 million when operations there were discontinued.

A stockholder asked for the views of the independent public accountants on the Corporation's By-Law under which the Audit Committee is given the authority to determine the scope of the audit. A representative of Haskins & Sells replied that in no case had any member of the Audit Committee or executive of General Motors limited or restricted the scope of the audit. Mr. Gerstenberg said that the Audit Committee reviews the scope of the audit with the auditors each year so that the Committee can determine whether the audit is broad enough and sufficiently detailed. The stockholder suggested, and the Chairman agreed, that the wording of the By-Law be studied. In response to a question, Mr. Murphy said the fee paid to the auditors for the 1971 audit totaled approximately $2.3 million, less than 0.01 percent of sales.

The proposal to ratify the selection of Haskins & Sells as independent public accountants for the year 1972 was approved by a vote of 235,820,654 shares for the proposal (99.61%) and 931,286 shares against the proposal (0.39%).

Item 3 — Board of Directors Proposal To Approve the Continuation of the General Motors Incentive Program, As Modified

The proposal to approve the continuation of the General Motors Incentive Program, as modified, was presented. The Chairman, speaking for the Board of Directors, said the proposal was the product of many months of study by the Bonus and Salary Committee, none of whose members are eligible for participation in the Program. Mr. Gerstenberg said that under the proposed Bonus Plan formula, as modified, the maximum amount which could be credited to the bonus reserve would be less than that under the present plan at all earnings levels. He added that the maximum number of shares which may be purchased through the exercise of options would not increase.

A stockholder opposed the proposal, saying that, in spite of the modification, he would submit a resolution next year limiting aggregate compensation for any individual employe to $350,000. A stockholder asked the Bonus and Salary Committee to recommend an incentive program for supervisors.

A proxyholder who is an officer of the United Automobile Workers union asked if GM would be opposed to a profit-sharing program for hourly workers based upon the annual profit of the Corporation. He said this would be a reasonable and rational way of settling differences, because the workers' equity would come into being only after the profits had been made. The Chairman said that the Corporation's contract with the

United Automobile Workers expires in the latter part of 1973, and, if this was a request the proxyholder, on behalf of the UAW, would like GM to consider, that would be the proper time to bring it up.

In response to several questions from a stockholder, the Chairman said the performance of individuals is a very important consideration with respect to bonus awards, and the Corporation has two plans under its Incentive Program—a Bonus Plan and a Stock Option Plan. He noted that stock used in connection with the exercise of options under the Stock Option Plan is newly-issued stock and stock used for bonus awards is acquired in the open market, adding that stock acquired by General Motors was well within the limit imposed by the SEC for company trading on the New York Stock Exchange. The stockholder stated she would submit a resolution in the future to disqualify from participation in the Corporation's Savings-Stock Purchase Program officers earning over $25,000 a year in salary and eligible for stock options. Another stockholder asked how many officers and employes received stock options and how many employes would receive a bonus this year. Mr. Gerstenberg replied that no stock options were granted either in 1971 or 1972 and that bonus awards related to the year 1971 were made to approximately 7,000 people.

In answer to further questions, Mr. Gerstenberg said the Bonus and Salary Committee has established eligibility with respect to those who would be considered for an award and that awards are recommended by divisional management and submitted to central office executives for review. The final determination as to who is awarded a bonus, and the amount of the bonus award, is made by the Bonus and Salary Committee. A stockholder asked how many women and blacks received bonus awards, and the Chairman replied that approximately 15 women and more than 30 members of minority groups received bonus awards for 1971. In response to an inquiry from another stockholder, he said under the new formula, if the Corporation earns less than $2.60 per share in 1972, there would be no bonus awarded to anyone.

The proposal to continue the General Motors Incentive Program, as modified, was approved by a vote of 233,806,744 shares for the proposal (98.78%) and 2,882,385 shares against the proposal (1.22%).

Item 4 — Stockholder Proposal To Limit Charitable Contributions Made by General Motors

The proposal to limit charitable contributions made by General Motors was submitted to the meeting by Mrs. Evelyn Y. Davis. The Chairman stated that the General Motors Board of Directors favored a vote against the proposal for the reasons set forth in the Proxy Statement, which indicated the Board of Directors believes that the Corporation has an obligation to make reasonable contributions to charitable, educational and similar organizations in geographical areas in which it operates, as well as to some of the large national charitable organizations. These contributions benefit GM both by maintaining its position as a good corporate citizen and by creating goodwill which is essential to the success of the business. The Board believes such contributions have been reasonable in amount and that the interests of the stockholders have been recognized and advanced.

In response to questions from the sponsor, the Chairman said the Corporation's contributions to charitable organizations for 1971, as reported in the Annual Report, totaled $8.1 million. In addition, he said, $4.8 million was contributed as educational grants and scholarship programs to colleges and universities, and another $2.8 million as educational aid to GM employes. In answer to further questions, he said GM contributed $125,000 to the United Negro College Fund and $630,000 to the Detroit United Foundation last year. Mr. Gerstenberg said also that the Corporation awarded scholarships to students attending approximately 200 colleges and universities across the country.

A stockholder opposed the resolution, citing the social obligations of corporations and stating that with record earnings and a special dividend, charitable contributions within limits can be afforded. Another stockholder asked the percentage of the Corporation's income used for charitable contributions. The Chairman indicated the percentage was less than 1 percent in 1971. A stockholder said General Motors and other corporations have a responsibility to devote a portion of their profits to the public interest.

A stockholder said profits belong to the stockholders, who could decide for themselves what to contribute. The stockholder also asked that a list of contribution recipients and amounts be made available. Another stockholder suggested that General Motors might form a foundation to administer contributions.

The proposal to limit charitable contributions made by General Motors was defeated by a vote of 5,209,171 shares for the proposal (2.24%) and 227,215,403 shares against the proposal (97.76%).

Item 5 — Stockholder Proposal To Provide for Regular Rotation of Independent Public Accountants

The proposal submitted by Mr. Edward C. Calvert to provide for regular rotation of independent public accountants was submitted to the meeting. The Chairman stated that the General Motors Board of Directors favored a vote against the proposal for the reasons set forth in the Proxy Statement. The Audit Committee regularly examines the advisability of changing or rotating the independent public accountants and was of the current opinion that change or rotation did not afford such clear and present advantage as to justify its adoption as a matter of corporate policy. The Haskins & Sells practice of regularly rotating its partners and supervisory personnel assigned to the General Motors audit has tended to assure a fresh viewpoint.

The sponsor asked the name of the company that pursues a policy of rotating its auditors and whether other auditing firms in the country were capable of handling the Corporation's audit. Mr. Gerstenberg said Morgan Guaranty Trust Company rotates its auditors and he presumed other auditing firms could find some way to expand if necessary. A stockholder opposing the proposal cited the expense of rotation, and another stockholder, speaking in support of the proposal, said competition among auditors would keep them responsible to the stockholders. Another stockholder, referring to the 100-word limitation imposed by the Proxy Rules upon the statements of stockholders in support of their proposals in the Corporation's Proxy Statement, suggested that management limit itself to 100 words in its reply.

The proposal to provide for regular rotation of independent public accountants was defeated by a vote of 2,816,319 shares for the proposal (1.21%) and 229,604,452 shares against the proposal (98.79%).

Item 6 — Stockholder Proposal To Reincorporate General Motors In the State of Michigan

The proposal submitted by Mrs. Wilma Soss and Messrs. Lewis D. Gilbert and John J. Gilbert to reincorporate General Motors Corporation in the State of Michigan was presented to the meeting. The Chairman stated that the General Motors Board of Directors favored a vote against the proposal for the reasons set forth in the Proxy Statement. The General Corporation Law of Delaware provides a sound, equitable and modern basis for corporate action. There is a substantial body of case law interpreting and applying Delaware law and establishing public policy affecting corporations organized in that State based on experience over many years. No persuasive reason existed why incorporation in Michigan, rather than Delaware, would benefit the Corporation.

One of the sponsors stated that if Michigan changed its laws to make cumulative voting permissive rather than mandatory, as at present, the need for Federal incorporation would become more obvious.

A stockholder said General Motors has more money invested in Michigan than in any other state and if it reincorporated in Michigan it would get more consideration from the state and local government. Another stockholder voiced support of the proposal, recommending that annual meetings be held in New York and that cumulative voting be adopted by the Corporation.

Another stockholder said states adopt corporation laws which will appeal to persons who select the state of incorporation, without regard to whether they are favorable to stockholders or other interests. Delaware is chosen, he said, because the Delaware Corporation Law is the most favorable to management, and he urged the company to reincorporate in Michigan until the option of Federal incorporation was available.

The proposal to reincorporate General Motors Corporation in the State of Michigan was defeated by a vote of 2,599,495 shares for the proposal (1.12%) and 229,818,883 shares against the proposal (98.88%).

Item 7 — Stockholder Proposal To Provide a Secret Ballot for Voting by Stockholders

The proposal to provide a secret ballot for voting by stockholders, submitted by Mrs. Wilma Soss, Mrs. Beatrice Kelekian and the Federation of Women Shareholders in American Business, Inc., was presented to the meeting. The Chairman stated that the General Motors Board of Directors favored a vote against the proposal for the reasons set forth in the Proxy Statement. General Motors has engaged the services of an independent specialist, C T Corporation System, since 1965 to assure confidentiality in voting and outside verification of the vote tabulation at stockholder meetings. A secret ballot voting procedure would be inconsistent with the general practice of other companies and would unnecessarily impose on General Motors an additional expenditure of money, time and personnel.

A stockholder supporting the proposal said corporations can put pressure on financial institutions and recipients of charitable contributions to vote for man-

agement. Another stockholder said it is not only employes, but those who wish to do business with a company, who must have this protection provided by a secret ballot. An employe stockholder said he had no compunctions about how he voted his stock, and that if he didn't agree with a management proposal, he voted against it.

The proposal to provide a secret ballot for voting by stockholders was defeated by a vote of 3,225,195 shares for the proposal (1.39%) and 229,158,717 shares against the proposal (98.61%).

Item 8 — Stockholder Proposal To Nominate a Woman for Director

The proposal to nominate a women for director, submitted by Mrs. Wilma Soss and the Federation of Women Shareholders in American Business, Inc., was presented to the meeting. The Chairman said the Board of Directors favored a vote against the proposal for the reasons set forth in the Proxy Statement, which pointed out the importance to the success of the Corporation of a Board of Directors comprised of persons with demonstrated superior ability and breadth of experience. Under this standard, no person is excluded because of sex or any other circumstance of birth.

A stockholder opposed having a woman director. The sponsor, in closing, said we are approaching the day when ability will be the most important factor in business life.

The proposal to nominate a woman for director was defeated by a vote of 4,798,107 shares for the proposal (2.06%) and 227,593,504 shares against the proposal (97.94%).

Item 9 — Stockholder Proposal To Nominate a Public Relations Counselor for Director

The proposal submitted by Mrs. Wilma Soss and the Federation of Women Shareholders in American Business, Inc. to nominate a public relations counselor for director was presented to the meeting. The General Motors Board of Directors favored a vote against the proposal for the reasons set forth in the Proxy Statement. Public relations expertise is always available to the Board, both through the various directors themselves and through specially trained and experienced company personnel and outside consultants. While no one would dispute the value of public relations, it is unwise to reserve Board memberships for persons identified primarily with particular occupations or professions.

A proxyholder said the growth of General Motors is dependent upon the consumer and such a director could give the consumer a direct line to have his complaints remedied. In reply to a stockholder question, Mr. Gerstenberg said the Corporation employs about 225 people on its central office public relations staff, but product problems are handled through divisional service offices located throughout the country, and not by the public relations staff.

A stockholder opposing the proposal was critical of public relations professionals. The sponsor said the Corporation's public relations have greatly improved, but further improvement in any field is always to be desired. The sponsor also said there should be a public relations counselor on the Board to advise the Board when it is reaching a decision.

The proposal to nominate a public relations counselor for director was defeated by a vote of 2,567,138 shares for

the proposal (1.10%) and 229,830,677 shares against the proposal (98.90%).

Item 10 — Stockholder Proposal To Require Reporting of Certain Information With Respect to General Motors Involvement in South Africa

The proposal, submitted by the Domestic and Foreign Missionary Society of the Protestant Episcopal Church in the United States of America, was presented to the meeting. The Chairman stated that the General Motors Board of Directors favored a vote against the proposal for the reasons set forth in the Proxy Statement. General Motors stockholders have received and will continue to receive detailed information concerning General Motors activities in South Africa. Accordingly, the proposal is essentially unnecessary.

The first speaker for the proposal said the information asked for was essential because it concerns the security and safety of a sizable investment, the wisdom of adding to that investment, the welfare of black labor forces, America's capitalistic image abroad and the historic faith and order of Christianity. He said economic and cultural gaps have widened in South Africa, and brotherhood, social justice and the rights of man have all but disappeared.

Another speaker for the proposal said any noncompetitive information relating to the stockholders' investment and possible impact on future earnings should be made available. While much information has been made available by GM, he said, it still falls far short of that requested. The speaker stated that workers he visited on a trip to South Africa said GM has been in South Africa for 46 years, yet had no black foremen and no black secretaries.

The Chairman said he had visited South Africa recently to inspect GM's facilities and to assure himself that the Corporation was doing all it could with respect to the serious racial problems in that country. He said he talked with high national and local government officials, journalists, authors, clergymen, businessmen and workers on assembly lines—African, colored and white—and their opinion was virtually unanimous that General Motors should remain in South Africa to continue its role in the forefront of progress in upgrading both the economic and social status of all the people. From no one in South Africa, he said, did he hear any responsible voice urging General Motors to abandon that country. On the contrary, the Corporation was urged to remain and continue its work. The Chairman said that he had spent a considerable length of time discussing these problems with nine white and nonwhite clergymen, and received a face-to-face vote of confidence from them. The day after he left, he added, the largest Johannesburg newspaper said: "As long as they stick it out and pursue the policy of improving the lot of nonwhite workers, they can do a tremendous amount to improve conditions here." The headline over this editorial read "Thank You, GM," Mr. Gerstenberg said.

Mr. Gerstenberg then stated the position of GM director Dr. Leon Sullivan, who abstained from voting on this proposal. Dr. Sullivan had advised the Board that if General Motors had the same proposal this year as last, requiring that GM withdraw from South Africa, he would vote in favor as he did a year ago. He feels, as we do, said the Chairman, that the principle of apartheid is wrong. Where we disagree, said Mr. Gersten-

berg, is the manner in which the situation can be improved and corrected. Dr. Sullivan still feels that withdrawal would be the best way to bring change, Mr. Gerstenberg said, while General Motors feels that its continued presence and continued efforts to work toward equality of opportunity for all people in South Africa is the best method. Dr. Sullivan indicated he felt that General Motors had made great progress and had made disclosure of some proportions regarding the South African operations, so he would not favor the resolution presented. On the other hand, said the Chairman, Dr. Sullivan felt he should abstain from voting in order to emphasize his strong convictions regarding the apartheid policies in South Africa.

A stockholder said there was great variation in the degree of discrimination by companies in South Africa. A proxyholder said this was essentially a moral issue, and that in recent years General Motors has come to acknowledge more and more that it must pay closer attention to its responsibilities to the community and to the public interest. The proxyholder said GM supports the South African system of government by continuing its operation there and could go far toward explaining its position by setting forth the information necessary to understand more fully what the Corporation is doing there. He said the economic gap between the haves and the have-nots is growing wider in South Africa.

Another proxyholder asked if nonwhites would be included in the recently announced dealership program in South Africa and to what extent blacks in this country would benefit from similar programs. Mr. Gerstenberg said GM's Motors Holding operation assists people in the U.S. who have the talent, managerial experience and background to enter the automobile business, but do not have the funds to provide the investment required. Motors Holding Division has been assisting minority citizens for many years, he said, but the worst thing that could be done would be to financially help an individual who did not have the proper experience. In South Africa, people are in training for some of the basic mechanical skills of this business, he concluded.

In response to a question from a stockholder and proxyholder, the Chairman said GM has a number of different classifications within the hourly and salaried groups in South Africa and has 147 nonwhites in training to become foremen. Under the laws in South Africa, he said, a black man cannot supervise a white man, but the Corporation is doing its best to qualify blacks as supervisors of black people. In response to a further statement, Mr. Gerstenberg said GM does not make military vehicles in South Africa, although it may sell commercial trucks to the government there. He also said GM had sold 50 diesel locomotives to the South African government. In reply to another question, the Chairman said General Motors does not move people from country to country in great numbers, with the exception of Germany, where there is a shortage of workers and where industry generally has brought in people from Italy, Spain and other countries.

A stockholder asked why the Episcopal Church felt its only responsibility as a stockholder is to concentrate on a single issue when it has responsibilities in America, as well as in South Africa. A proxyholder said his group was very interested in every aspect of General Motors' performance and did not believe that U.S. corporations should leave South Africa, but was cast-

ing its votes in favor of the proposal because there was no valid reason why GM should refuse to disclose the precise information requested. The proxyholder thanked GM for the cooperation received during a visit to GM operations in South Africa and during conversations with the Chairman, but said he was voting for the proposal because of a belief that GM is in a position to be a leader in the business community's growing readiness to shoulder all of its social responsibilities.

A stockholder commended the Chairman on his willingness to go to South Africa, and asked if there would be an opportunity for General Motors to disclose more information regarding its operations there. The Chairman replied that GM had put out information far beyond that published or disclosed by any other company. A proxyholder said no black man in South Africa is allowed to own land, and 80 percent of the population is not allowed to vote. Jobs, wages and chances for advancement are dictated by the color of a man's skin, he said. The proxyholder added that while the president of the major colored labor party said General Motors has contributed toward improvement in South Africa, he also said American companies working inside the apartheid system are helping the minority rule.

In response to questions, Mr. Gerstenberg said he left South Africa with the feeling that the gap is narrowing in favor of all the people, and that General Motors will continue its operation there and will make a contribution to all the people, particularly those who have not gained the equality to which they are entitled. He said GM has 10 or 11 classifications of hourly workers in South Africa and that wage increases had been granted in the past year to some nonwhite employes and other adjustments are scheduled later this year.

A stockholder said Dr. Leon Sullivan should speak for himself and, in response, Dr. Sullivan addressed the meeting. He said apartheid is the most ruthless system affecting human beings in the world today, and that he has stated that every American-based company in the Union of South Africa contributes to the continuation of that policy. It is a question, he continued, of man's inhumanity to man, and if General Motors can favorably affect conditions of employment and the equality of wage opportunities, he would have no question of GM remaining there. He said he wants General Motors to do what it can to change the system to bring down apartheid. Dr. Sullivan also said that if withdrawing can change the system, withdraw. If staying there changes the system, stay there, but above all, change the system, he said.

The proposal to require reporting of certain information with respect to General Motors involvement in South Africa was defeated by a vote of 5,436,998 shares for the proposal (2.34%) and 226,882,532 shares against the proposal (97.66%).

Item 11 — Stockholder Proposal To Establish a Committee to Study the Desirability of Dividing General Motors Into Two or More Separate and Independent Corporations

The proposal was presented by a representative of the Project on Corporate Responsibility, Inc. The Chairman stated that the General Motors Board of Directors favored a vote against the proposal for the reasons set forth in the Proxy Statement. General Motors management is engaged in continual studies of the organization

structure and operations of the company. Reflecting such studies, the Corporation has undertaken new activities which appeared promising, reassigned responsibilities internally in the interest of greater efficiency and had refrained from or discontinued unpromising activities. There is no evidence that General Motors overall would perform more efficiently, or as efficiently, if it were smaller. The Corporation has grown and will grow consistent with its ability to attract and retain customers in the highly competitive environment in which it operates.

The first speaker for the sponsor said the resolution raises the question of whether the whole of General Motors is less than the sum of its parts and that, despite management and stockholder apathy, the public will ultimately demand answers to this question.

The second speaker said that the automobile industry . a shared monopoly. He cited studies concluding that monopoly pricing policies result from monopoly structures and asked that the effect of economic concentration on technological innovations be considered, saying this has discouraged the development of new technology in the automobile industry. Phase II wage and price controls should be a warning to every GM stockholder of the consequences of a decision to continue to ignore the problem faced by GM's holding such a major share of the market, he said. The threat of antitrust action effectively limits the market share of a company, he concluded, and asked that the proposal be studied before the government orders GM to divide into separate companies.

A stockholder said he believed there was a great danger of moving toward government ownership of big businesses, and asked if the management had seriously considered the possibility of breaking up the Corporation into smaller units. The Chairman replied that he had given the matter no consideration. A stockholder said there might be more profitable opportunities if General Motors were broken up, thus benefiting the stockholders. Another stockholder said GM should be divided into ten or twelve parts, each a publicly-owned company. An employe stockholder questioned whether the assets of the Corporation would produce more revenue through separate companies and said dividing General Motors would be detrimental to stockholders.

A stockholder asked if breaking up General Motors would affect national defense, saying it was important in the event the nation had to rally its forces very quickly to have a company able to do what General Motors did in World War II. The Chairman agreed, saying that big companies can convert very quickly in the event of a national emergency. He added that GM had discontinued some operations over the years when it felt it was no longer good business to continue them. In other instances, he said, the Corporation has combined operations or divisions, and the time of GM executives would be much better spent in pursuing the business of the Corporation in order to sell more products, employ more people and pay more dividends, than in studying such a proposal.

The Chairman pointed out that many staff activities are centralized. He said he had no knowledge of any antitrust action on the part of the government regarding the size of GM. The General Counsel added that as long as a company grows from within as a result of doing a better job, the antitrust laws should have no

application to its growth. A proxyholder suggested that the United Automobile Workers be investigated for the imbalance of power he said it enjoys in the labor market. A stockholder said it seems fashionable to penalize the success of the Corporation, but we should not forget that GM is a great corporation.

A proxyholder said dividing GM would be good for consumers, who would pay less for more up-to-date products, good for workers, who would face a smaller threat from foreign competition, and good for stockholders because their investment would grow more aggressively. He urged adoption of the proposal, and said he was confident a study would show that GM is too big for the good of the country.

The proposal to establish a committee to study the desirability of dividing General Motors into two or more separate and independent corporations was defeated by a vote of 2,426,243 shares for the proposal (1.04%) and 229,969,153 shares against the proposal (98.96%).

Item 12 — Stockholder Proposal To Require the Public Policy Committee to Hold at Least Four Meetings Each Year That Are Open to the Public and to Report Committee Activities to the Stockholders

The proposal was presented by a representative of the Project on Corporate Responsibility, Inc. The Chairman stated that the General Motors Board of Directors favored a vote against the proposal for the reasons set forth in the Proxy Statement. Public participation in the activities of the Committee would not allow the frank and responsive discussions among Committee members and with individuals invited to present other viewpoints which are promoted by executive sessions. The proposed reporting requirement would divest the Board of discretion with respect to the disclosure of information relating to the efforts of the Public Policy Committee. Accordingly, the Committee's value to the Board, the Corporation and the stockholders would be substantially reduced by the adoption of this proposal.

The first speaker for the proposal said criticism developed by the Public Policy Committee can be ignored by management under the present ground rules. The requirement of disclosure can counteract this effect, he said, and there would be no breach in confidentiality to the extent the Committee believes it needs it. The speaker said self-criticism is necessary for corporations, and the sponsors of the proposal wished to institutionalize a sensible but effective method of self-criticism. A stockholder suggested the Public Policy Committee hold an open meeting once a year.

In response to a comment complimenting GM for sending copies of "Progress in Areas of Public Concern" to all stockholders, Mr. Gerstenberg noted that the Corporation had sent a total of 335 pages of information to stockholders within the past year at a cost of $3 million because of the desire of management to inform the stockholders about what is going on within the Corporation. In answer to a question from another stockholder, the Chairman said the Public Policy Committee spent a tremendous amount of time looking into GM's staff activities and held a series of meetings with minority and consumer groups and ecologists. He also said the formation of the Science Advisory Committee was a direct result of the activities of the Public Policy Committee and noted that the Public Policy Committee

had urged GM to continue its work in South Africa. Mr. Gerstenberg said the Committee should be judged on the basis of whether or not General Motors was performing as it should.

A stockholder speaking on behalf of the sponsor said he felt the Public Policy Committee was useful, but that stockholders should get the benefit of the Committee's thinking before management had a chance to examine it. He said the sponsors felt the idea of outside voices in the decision-making process is useful, and that both the company and the community are the better for it.

The proposal to require the Public Policy Committee to hold at least four meetings each year that are open to the public and to report Committee activities to the stockholders was defeated by a vote of 2,598,655 shares for the proposal (1.12%) and 229,927,537 shares against the proposal (98.88%).

Other Comments and Discussion

In response to a question from a proxyholder, Mr. Gerstenberg said General Motors would consider the production of weapons if the government felt it needed material to protect the country, and the Corporation had the ability and facilities to produce it. In reply to a series of questions, the Chairman said about 15 percent of GM's total U.S. work force is comprised of minority citizens, that the Corporation has no application before the Price Commission for price increases, that the Corporation planned no layoffs, and that its deposits in the National Bank of Detroit did not exceed 1 percent of that bank's total assets. In reply to a question as to whether GM planned to use the Wankel engine in the 1973 Chevrolet Vega, President Edward N. Cole replied that GM had no such plan.

A stockholder offered his encouragement to the management of General Motors for its determined efforts in the area of pollution control, and said some individuals and groups must not be allowed to jeopardize sound technological advances or risk the loss of thousands of jobs by ill-conceived solutions to such problems as air pollution. A stockholder said he had read reports that the Corporation had let contracts for the production of the Wankel engine. Mr. Cole said GM has no production plans, but is working diligently in research and engineering staff activities to prove out the engine. There are many deficiencies in the engine and problems which are not solved, he said.

A stockholder asked the cost of recall campaigns. The Chairman replied that while the cost had not been disclosed, it was not a great amount of money and noted competitors do not make public this cost information. In response to further questions from the stockholder, Mr. Gerstenberg said the forecast for spending on pollution control by GM in 1972 is $300 million—$225 million for research, engineering, inspection and testing with respect to emissions from vehicles, and $75 million for the control of air and water pollution from the Corporation's plants. In reply to another question, he said the Corporation has adequate protection, including insurance, to cover contingent liabilities.

A stockholder asked if GM had any plans to install steel-belted radial tires on its products, and was told by Mr. Cole that they already are optional on some GM cars and are in limited supply because of the shortage of the type of steel needed to manufacture them. A proxyholder said he was grateful for what he had heard in

terms of the social responsibility of General Motors, but said the group he represented was uncomfortable with the defense contracts that General Motors has. The Chairman replied that he wished there were never a war, and said the Corporation's government sales last year consisted of aircraft and diesel engines, automotive products used by the government and the completion of a rifle contract early in the year. A stockholder asked if hydrogen had been considered as a substitute for gasoline to eliminate pollution. Mr. Cole replied that GM is constantly exploring this matter, and if at some time there is sufficient atomic energy, it may be possible to extract hydrogen from water and then combine it with something to use in place of gasoline.

In response to a number of questions from a stockholder, Mr. Gerstenberg said GM operated 16 company airplanes at a cost of approximately $9.7 million, including depreciation, last year; is converting an assembly plant in Canada to produce the Chevrolet Vega; and has no plans to produce tires. Mr. Malone, in response to one of the questions from the stockholder, said the indictment against GM and Ford handed down by a Federal Grand Jury charged that there had been a conspiracy to eliminate fleet subsidies and thereby increase the price of automobiles and that GM and Ford had conspired to monopolize fleet sales in the country. The charges assert that by the public statements of the two companies, they had sufficiently communicated to constitute an agreement or a conspiracy. In reply to another question, Mr. Murphy said the Corporation spent $227 million—or about 0.8 percent of sales—on advertising last year, compared with $205 million, or 1.1 percent of sales, in the previous year.

MR. GERSTENBERG'S CLOSING STATEMENT

We appreciate more than we can say your attendance here today, your questions, and particularly the cooperation you have given us this past year.

Today we have discussed the business and the affairs of General Motors. We have listened to you—the owners of the business. We have listened and we have learned. Your comments and suggestions will help to guide us in the days ahead.

As I said earlier, General Motors today remains a dynamic composite of problems and opportunities. We do have problems, in the industry and in General Motors. But all businesses have problems. We like to think, however, that every problem presents us with a new opportunity. The successful business is the one that converts those problems into opportunities. This General Motors has always done, and this we intend to continue to do.

I have great confidence, a confidence born of my 40 years with General Motors, in all the people of this great Corporation and in their collective ability to serve our customers, to return a profit to you, the owners, and to continue to serve the needs of America.

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